Screening Gait Performance, Falls, and Physical Activity among Benedictine and Trappist Monks

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Abstract

Background and Objective: Physical performance in older men has been reported in analyses with veterans and in disease-based cohort research. Studies examining gait performance among older monks, however, are narrow. The purpose of this study was to analyze the impact of a recent fall on gait ability in a cohort of Benedictine and Trappist monks in 4 US monastic communities. The second aim was to analyze physical activity and a recent fall as predictive markers of 2 constructs of gait performance. Methods: In this cross-sectional study, 53 Benedictine and Trappist monks over 60 (x = 74.7 ± 7.6; range: 61-94 years) completed a basic sociodemographic and fall history profile, the Timed Up and Go (TUG) Test, Dynamic Gait Index (DGI) and the Physical Activity Scale for the Elderly (PASE). Results: Demographic profiles revealed that 10% of participants had fallen over the past 3 months; in addition, those who had fallen were more likely to limit activities because of fear of falling (P = .005). Monks who had fallen over the past 3 months demonstrated significantly poorer TUG (12.6 ± 2.1 vs 10.5 ± 1.8; P = .01) and DGI (17.2 ± 5.3 vs 22.3 ± 2.3; P < .001) scores. There was a significant association between physical activity and both the TUG (–0.55; P < .001) and DGI (64; P < .001). Multiple regression models demonstrated that physical activity and a fall in the past 3 months predicted 24% of the variance in the TUG (P < .001) and 46% of the variance in the DGI (P < .001). Conclusions: Gait performance is linked to a recent fall episode among older monks. Predictive determinants of functional mobility (TUG) and superimposing tasks on the gait cycle (DGI) include recent fall history and physical activity. Appropriate health promotion activities can be aligned with these lifestyle attributes in monastic communities.

Keywords
fall, physical activity, gait

Introduction

Sociodemographic and physical health factors impact functional independence and longevity in older adults.¹,² Studies pertaining to physical performance in older men have traditionally taken 1 of 3 approaches: (1) performance clustering by 10-year age cohorts, (2) investigations with large population condition–based samples such as men with osteoporosis, and (3) studies with focused men’s groups such as the veteran population.²-⁵ Analyses have targeted multiple constructs of physical performance including balance, gait, and activities of daily living.⁵ These studies have portrayed the challenges encountered by older men in health promotion.

Falls and fall-related injuries are associated with higher health care costs, decreased quality of life, and disability.⁶,⁷ Older men are more likely to die from a fall.⁸,⁹ Men have unique medical and social conditions which may affect physical health and falls. For example, falls in men have been linked to lower bioavailable testosterone, physical activity, androgen deficiency, and depression.³,⁴,¹⁰,¹¹ Those who are frail have a greater incidence of recurrent falls, fracture, and disability.¹² Population-based studies have generally examined single or recurrent fall episodes incurred over the past year; the influence of fall history over the past 3 months, however, has been less identified and reflects a literature gap.³,⁹

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Physical activity is linked to both falls and gait performance in older men and is a cornerstone of the frailty phenotype.10,13 Jeffers reported that men who were recurrent fallers spent more time in sedentary behavior.10 Similarly, household physical activity declined following an injurious fall among male veterans.14 Moderate-intensity physical activity is positively associated with both gait speed and single leg stance performance in older men.15

Our unique approach in this exploratory study was to examine locomotion, physical activity, and recent falls in a special population of older men, Benedictine and Trappist monks. The analysis was a component of a larger liturgical initiative to analyze physical performance in Catholic clergy.16 Prior studies with clergy and nuns have afforded insight into dementia conditions, physical decline with aging, and resiliency.17-19 For example, Shah et al18 demonstrated that Catholic clergy and nuns with a systolic blood pressure of 160 mmHg or more demonstrated a greater decline in lower extremity function. Wells et al19 noted a positive correlation between resiliency and maximum gait speed among older nuns.

Roman Catholic monks lead a unique vocation dedicated to their respective orders. Decreased mortality has been associated with some contemplative Benedictine and Trappist orders because of the simplistic lifestyle.20 Prayer services are attended several times daily, and communal work activity can be dedicated to a specific service activity. Examples include vegetable gardening, woodworking, and herb-based liquor production. Missions abroad are associated with some orders, whereas others are linked to academic instruction and community work. Requisite gait function and physical activity are essential to perform daily duties.20 Focused physical performance and locomotion studies in monks exclusively are rare.

The objectives of the study were to explore the interaction between recent fall history, physical activity, and gait in a physical performance screen. Specifically, the first aim was to determine the effect of a recent fall on gait performance in a cohort of Benedictine and Trappist monks. The second objective was to examine physical activity and a recent fall as predictive determinants of 2 constructs of gait. We hypothesized resultant differences between faller and non-faller gait ability, and that a recent fall and physical activity would be predictive determinants of gait performance.

Methods
A descriptive cross-sectional design was used to examine physical performance in a convenience sample of Benedictine and Trappist monks 60 years of age and older. The study was approved by the Institutional Review Board and monastery senior officials. All participants signed the informed consent. Testing occurred at 4 monastic communities in the United States. Inclusion criteria mandated independent ambulation with or without an assistive device and independent sit to stand performance over 5 trials. The protocol criteria excluded clergy with cognitive impairment and chronic neuromusculoskeletal or cardiopulmonary pathologies that would preclude test performance, including Parkinson’s disease, multiple sclerosis, end-stage chronic obstructive pulmonary disease or organ failure, and terminal cancer. The Six Item Cognitive Screener was utilized to determine orientation, memory, and cognitive readiness for fall and medical history questions.21

Participants completed an initial eligibility screen requiring at least 20/40 vision with lens correction, intact protective foot somatosensation, and no prohibitive vestibulo-ocular dizziness.22-24 The testing session for each participant lasted approximately 55 minutes. Blood pressure and body mass index (BMI) were obtained. Participants responded to a demographic survey regarding their medical and fall histories, including fear avoidance and polypharmacy questions. A fall was operationalized to represent an unintentional contact with the ground with subsequent medical follow up.25 Physical activity was assessed with the Physical Activity Scale for the Elderly (PASE). The PASE demonstrates appropriate reliability and validity for measuring 3 areas of physical activity in older adults: leisure, household and work-related tasks.26,27 Concurrent validity with activity monitoring has been established, along with test-retest reliability.27,28 Comprised primarily of ordinal-based questions, the instrument was congruent with those daily functions performed by monks on a weekly basis. Hours of activities spent in the activities translates to a final calculated index, with higher scores indicating greater activity.

Gait dependent variables included 2 tests of gait performance, the Timed Up and Go (TUG) test, and Dynamic Gait Index (DGI). During the TUG procedure, participants stood from a uniform armchair following the go command, walked a 3-m course at their usual velocity, and returned to the seated position.29 The test demonstrates validity and reliability metrics in the older adult population, including an association with executive function.30-32 In contrast, the DGI requires modification of the gait cycle through 8 task demands that include velocity changes, stepping over obstacles, and stairs negotiation.33 Twenty-four points are possible. The instrument demonstrates appropriate reliability and concurrent and predictive validity; Shumway-Cook and colleagues determined that older adults with scores below 19 were at elevated risk for falls.33,34

Descriptive statistics (mean and standard deviations) were obtained for participants’ sociodemographic and physical performance characteristics. The Shapiro-Wilk test evaluated normality of variable distributions. Bivariate analyses
included exploratory parametric independent $T$ tests (normally distributed variables), nonparametric Mann–Whitney $U$ tests, and Fisher’s Exact test to assess demographic recent fall history differences. Two directed ANOVA analyses examined the effect of recent fall history on TUG and DGI performance with adjusted covariate controls (ANCOVA).

Pearson product moment and nonparametric Spearman rho correlations were utilized to investigate the association between physical activity, gait tests, and continuous demographic variables. Two nested multiple regression models were constructed for each gait measure, with physical activity and recent fall history treated as independent variables.

Data were analyzed with SPSS version 26 (SPSS Inc, Chicago, IL) using $a=0.05$, with a sharpened level $(\alpha=0.025)$ for the 2 gait ANCOVA comparisons for recent fall risk. An a priori power analysis (.80 power level) was used to determine sample size for entry of 2 independent predictors into the regression models. Preliminary relative intra-rater reliability was established for both gait measures (>0.90), including individual DGI item kappa ordinal reliability (>0.94).\textsuperscript{35}

**Results**

Sixty-six monks were initially screened, and 53 (43 Benedictine and 10 Trappist) participants met the inclusion criteria. Reasons for exclusion included severe dizziness (1), mobility dependence (5), end stage cardiopulmonary disease (3), impaired cognition (1), blindness (2), and terminal cancer (1). Testing sites included monastic communities in Minnesota, Pennsylvania, North Carolina, and South Carolina. Comorbid medical conditions and anthropometric measures are listed in Table 1. Most monks participated in regular physical activity, although fewer participated in a structured exercise program. Participants were generally well educated with college degree attainment. Ten percent reported falling in the preceding 3 months. Monks who had fallen over the past 3 months were more likely to limit their activities because of fear of ability (>0.90), including individual DGI item kappa ordinal reliability (>0.94).\textsuperscript{35}

### Table 1. Participant Profile.

| Demographic and performance profile (n=53) | M (SD) [95%CI] |
|------------------------------------------|---------------|
| Age (years)                              | 74.7 (7.6) [72.8-77.0] |
| Six item screener (6 pts max)            | 5.5 (9) [5.2-5.7] |
| BMI (kg/m$^2$)                           | 28.7 (4.8) [27.2-29.9] |
| Systolic blood pressure                  | 128.2 (12.4) [124.7-131.8] |
| Diastolic blood pressure                 | 76.1 (8.9) [73.7-78.6] |
| Number of medications                   | 4.2 (3.5) [3.2-5.2] |

| Describe general health and activity     | (# Yes, %) |
|------------------------------------------|------------|
| Excellent                                | 6 (11.3)   |
| Good                                     | 38 (71.7)  |
| Fair                                     | 9 (17.0)   |
| Performs regular activity                | 36 (67.9)  |
| Participate in structured exercise activity? | 14 (26.4) |

| Medical conditions                       | (# Yes, %) |
|------------------------------------------|------------|
| Heart disease                            | 18 (34.0)  |
| Diabetes                                 | 7 (13.2)   |
| Depression                               | 5 (9.4)    |
| Prostate problems                        | 23 (43.4)  |
| GI problems                              | 10 (18.9)  |
| Cancer                                   | 9 (17.0)   |
| Total joint replacement                   | 6 (11.3)   |

| Fall-related variables (#, %)            |            |
|------------------------------------------|------------|
| Fall in past 3 months                    | 6 (11.3)   |
| Fear of falling limit activities?        | 9 (17.0)   |
| Take 4 or more medications?             | 26 (49.1)  |

| Gait and physical performance            | M (SD) [95%CI] |
|------------------------------------------|---------------|
| Timed up and go test (s)                 | 10.7 (1.9) [10.2-11.3] |
| Dynamic Gait Index (24 pts max)          | 21.7 (3.2) [20.8-22.6] |
| Physical activity scale for the elderly (#) | 136.0 (90.3) [110.8-161.1] |

### Table 2. Predictive Determinants of the Timed Up and Go Test (n=53).

| Independent variables* | B    | SE B | $\beta$ | t    | $P$ |
|------------------------|------|------|---------|------|-----|
| Fall in past 3 months  | 1.7  | .74  | .29     | 2.3  | .025|
| PASE                   | -.008| .003 | -.40    | -3.3 | .002|

*Adjusted $R^2 = .24$.

### Table 3. Predictive Determinants of the Dynamic Gait Index (n=53).

| Independent variables* | B    | SE B | $\beta$ | t    | $P$ |
|------------------------|------|------|---------|------|-----|
| Fall in the past 3 months | -4.4 | 1.0  | -.45    | -4.3 | <.001|
| PASE                   | .02  | .004 | .47     | 4.5  | <.001|

*Adjusted $R^2 = .46$.

was not detected with regression diagnostics; additionally, significance of the predictors was not attenuated in models with age or BMI.
Discussion

This is the first study to examine 2 widely used constructs of gait performance in a focused population of older men, Benedictine and Trappist monks. Monastic communities can be restricted to outsiders and studies among clergy, particularly monks, remain limited. Though a decreased mortality has been linked to the simplistic Benedictine and Trappist lifestyle, higher rates of self-reported disability have been described compared to the general population. Machenbach et al suggested that a judicious lifestyle might benefit mortality at the cost of morbidity. Other ministry studies have proposed that interventions targeting obesity and chronic diseases be a priority given high prevalence rates and occupational stress.

The intertwining of gait performance with fall history is complex. Slower gait velocity is predictive of adverse events in older adults, including hospitalization and falls. Conversely, older men with recurrent falls retrospectively have demonstrated poorer gait performance. Our findings support that monks with a recent fall demonstrate poorer locomotor ability on gait measures. Interestingly, fallers performed poorer and traversed traditional cutoff scores recognized for fall risk on both tests compared with non-faller performance.

Physical activity mirrors a level of routine functional performance in occupational, leisure, and household tasks and is germane throughout the monastic cloistered lifestyle. In the Osteoporotic Fractures in Men study, Janney et al illustrated a longitudinal decline in physical activity among older men using the PASE tool over a 5-year trajectory, particularly those in the poorest health. Better physical and mental health plus living with others were associated factors with temporal improvement in physical activity. Previous work has noted the relationship between physical activity and gait, though the variable of interest was gait velocity. For example, Morie and colleagues demonstrated that older men more physically active demonstrated faster gait speed than less active peers. The authors also noted a significant correlation between gait speed and physical activity (r = .40; P < .05), an association analogous to our observed correlation between physical activity and the TUG. This relationship further supports our hypothesized connection between the 2 domains, with increased physical activity positively linked to better gait performance.

The dilemma of falls and physical activity among older men warrants discussion. Jefferis et al reported a lower activity level among older men with recurrent falls, including fewer steps per day and less minutes in mild, moderate, and vigorous activity. While studies endorse fall risk among older men in poorer health, converse data suggest that falls also can occur in the very active sector of older males with preserved leg strength. Contributing factors hypothesized include riskier behavior, an over-inflated sense of capability, and a mismatch between actual and perceived gait ability. Kelsey et al cited a distinct difference between indoors and outdoors fallers; determinants of outdoors fall included male gender and a higher activity level. While we did not see a significant difference in physical activity between recent fallers and nonfallers, this could be attributed to the blend of activity intensities, both high and low, among the monks.

Inquiring about recent fall history over the past 3 months underscores the need for immediate interventions. Grundstrom et al indicated that risk factors for a recent fall in their gender-mixed study included male gender, poorer health, age, and BMI. It should be noted that older adults may fail to recall fall episodes or underreport recurrent falls over longer durations. Among the monks, those who had fallen over the past 3 months were more likely to limit activities because of fear of falling. A recent fall should thus be regarded as a serious event linked to gait deficits which can, in turn, potentiate a downward functional cascade, including fear of falling and decreased physical activity. Though limited by our cross-sectional design, it is plausible that older men who have recently fallen reduce both speed and degrees of freedom in locomotion with fear avoidance. Bass et al suggested that older men should be screened for falls more thoroughly. Furthermore, 1 in 3 male veterans who sustains a hip fracture dies within 12 months.

There are 2 large previous initiatives involving Catholic clergy: the Nun’s Study and the Religious Order’s Study. Gait variable studies included velocity and extrapyramidal bradykinesia and rigidity symptoms. Wilson and colleagues noted that gait disorders with Parkinsonian symptoms were strongly associated with mortality among Roman Catholic clergy. Our findings compliment these 2 existing investigations by providing data more specific to gait performance beyond velocity, though 2 major differences prevail. Our approach was to analyze physical performance through a focused gait assessment, with less emphasis on dementia constraints. Second, our design did not involve longitudinal follow-up and brain donation, key components of both the Nun Study and Religious Order’s Study.

Gait performance is a key assessment in geriatric rehabilitation, and gait disorders are common and reflect locomotor degradation. Of the 2 primary gait dependent variables, less data exist which reflects older men’s performance on the Dynamic Gait Index. Unique in its construct, the DGI measures an individual’s ability to overlay tasks on the basic gait cycle. Physical activity represented a larger percentage of the variance compared with the TUG, possibly to the more challenging activities associated with tests. Herman et al noted men were less likely to use the rail in the final stairs task component.

Our findings have 3 major implications for health promotion and screening. First, performance values can be
used for future age-related comparisons when managing this religious sector in screens and primary care settings. While previous work has noted that Benedictine and Trappist monks have greater self-rated disability, including standing rise times, our mean values did not deviate meaningfully from performance values previously reported for the TUG or DGI. Second, our findings reiterate the importance of the link between physical activity and gait ability. Finally, as determinants of gait performance, fall risk and physical activity can be embedded within a directed plan of care. Primary care health professionals often perform interventions with clergy in religious communities, including rectories, convents, and liturgical retirement homes. Our findings offer evidence that effective assessment with salient outcomes measures can further extend to monastic communities. Older monks continue to stay active performing duties that include college tutoring, teaching, and other contributions to the order. Wellness activities that address fall history, screen gait performance, and evaluate physical activity can serve to enhance health promotion and quality of life.

Screening findings can facilitate intervention activities. Religious domiciles are candidates for seminar-structured fall prevention programs like Stepping On and A Matter of Balance for clergy and nuns. These programs could be administered within the facility and embed exercise activities. Cognitive-behavioral strategies would also target enhancing balance confidence; given the large number of monks who disclosed fear of falling, this would particularly be beneficial. Some clergy might be candidates for a more individualized rehabilitation program in physical therapy to improve strength, balance, and reactive stepping strategies to reduce fall risk, improve falls efficacy, and enhance quality of life.

Given the focused nature of sample, our data cannot be generalized to all community-dwelling men. As well, the cross-sectional design of the study precludes causal data interpretation. Gait tests were selected based upon a wide variety of functional levels among participants; however, several monks scored a perfect score on the DGI. Future studies may elect to administer a higher-level test with more challenging tasks. The study was powered to detect 2 key outcomes on the gait tests. Descriptive outcomes on the gait measures are in line with performance values previously recorded. Findings serve as a catalyst for health promotion screening and intervention management in monastic communities.

Conclusion

Benedictine and Trappist monks with a recent fall demonstrated poorer performance on the TUG and DGI assessments. Physical activity among these men is positively associated with both gait tests. A recent fall and physical activity jointly were significant predictive determinants of the TUG and DGI. Descriptive outcomes on the gait measures are in line with performance values previously recorded. Findings serve as a catalyst for health promotion screening and intervention management in monastic communities.

Declaration of Conflicting Interests

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