

Malnutrition as a Fall Risk Factor

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Examining various aspects of malnutrition in elderly patients
may be helpful in determining the risk of falls.

Falls often result in injuries with devastating outcomes. In the elderly, falls are the largest cause of injury, mortality, and functional decline, leading to 40% of nursing home admissions.¹ Nationally, falls with injury are estimated to cost \$19 billion in direct medical costs.² According to the National Quality Forum (NQF), hospital falls resulting in injury are reportable events. Beginning in fiscal year 2015, reportable events labeled as hospital acquired conditions (HAC) are subject to nonpayment, creating increased regulatory and reimbursement pressure on hospitals.³

Due to the major impact of a fall, The Joint Commission (TJC) requires hospitals to assess a patient's fall risk on admission and whenever the patient's condition changes.⁴ Despite decades of research evaluating various predictive strategies to identify individuals at fall risk, nutritional issues as interactive risk factors have received little attention.

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A comparative study on the validity of fall risk assessment scales revealed that tools claiming to predict risk factors do not work well.⁵ Falls are the result of multiple interactive, synergistic pathologies and risk factors. In a multivariate regression study conducted by Lichtenstein and colleagues in Canada, lower body weight was found to be a statistically significant risk factor for falling.⁶ In 2004, Oliver and colleagues conducted a systematic review of fall risk assessment tools that included validation testing with sufficient data to allow for calculation of sensitivity, specificity, negative and positive predictive values, odds ratios, and confidence intervals.⁵

Fourteen studies identified common fall risk factors. The majority of these studies identified impaired cognition as a risk factor.⁵ Of the 14 studies included in the systematic analysis of Oliver and colleagues,⁶⁻¹⁹ 6 identified medications,^{6,8,11,12,17,18} and 8 noted weakness and unsteady gait as risk factors.^{6,9-11,14,16,18,19} Only 1 study noted anemia as a risk factor for falls among patients who were post cerebral vascular accident.¹¹ Additionally, only 1 study noted an association between falls resulting in hip fracture and lower body weight.⁶

One in 4 adults admitted to a hospital is malnourished.^{20,21} Com-

ponents of malnutrition, including but not limited to anemia, clinically significant weight loss, and vitamin D deficiency, may be unrecognized interactive risk factors that increase the risk of hospital falls. Malnutrition and dehydration symptoms include fatigue, dizziness, irritability, loss of muscle mass, impulsivity, and the potential for poor judgment. Therefore, it is likely that the severity of specific malnutrition parameters is associated with recurrent falls and possibly injurious falls.

Hunger and inadequate food intake due to chronic disease or chronic food insecurity are real issues for the elderly. Insufficient caloric intake often leads to slow, progressive, and often unnoticed weight loss. The Academy of Nutrition and Dietetics (AND) and the American Association of Parenteral and Enteral Nutrition (ASPEN) have defined clinically significant weight loss categories to aid in the diagnosis of malnutrition. To aid in the diagnosis of various degrees of malnutrition, clinically significant weight loss is classified as $\geq 5\%$ weight loss in 30 days; $\geq 7.5\%$ weight loss in 90 days; $> 10\%$ in 180 days.²¹ The World Health Organization (WHO) identifies iron deficiency measured by hemoglobin (Hgb) value (for men < 13 g/dL) as the most common and

Table 1a. WHO Malnutrition Guide^a

Iron Level	Hemoglobin value
Normal	13.0-17.2 g/dL
Mild deficiency	9.5-12.9 g/dL
Moderate deficiency	8.0-9.4 g/dL
Severe deficiency	< 8.0 g/dL

Table 1b. ASPEN/AND Recommendations for Diagnosis of Malnutrition

- Insufficient energy intake
- Weight loss
- Loss of muscle mass
- Loss of subcutaneous fat
- Localized or generalized fluid accumulation
- Diminished functional status

Table 1c. Chronic Illness Weight Loss Defined

Significant weight loss in the context of chronic illness or in the context of social or environmental circumstance is defined by ASPEN/AND as follows:

- 1 month: > 5% weight loss is severe
- 3 months: > 7.5% weight loss is severe
- 6 months: > 10% weight loss is severe
- 12 months: > 20% weight loss is severe

Abbreviations: ASPEN/AND, American Association of Parenteral and Enteral Nutrition/Academy of Nutrition and Dietetics; WHO, World Health Organization.

^aAll participants were men.

widespread nutritional disorder in the world (Tables 1a, 1b, and 1c).²²

Eat Well, Fall Less is a retrospective chart review approved by the Louis Stokes Cleveland VAMC (LSCVAMC) Internal Review Board. The review seeks to determine whether degree of weight loss and decline in Hgb and vitamin D deficiency, factors of malnutrition, are present in recurrent fallers vs single-event fallers. Researchers hypothesized that individuals who experienced recurrent falls during hospitalization would demonstrate a greater degree of clinically significant weight loss compared with those who had experienced a single fall. The second hypothesis was that recurrent fallers also would have lower Hgb values than that of single-event fallers. The tertiary hypothesis was that individuals with a greater degree of vitamin D deficiency were more likely to be recurrent fallers compared with single-event fallers.

In addition, dementia has been previously identified as an independent risk factor for falls and recurrent falls.²³ During phase 2 of the study, the researchers hypothesized that in individuals with dementia, the concurrent diagnosis of malnutrition would be greatest in the recurrent fall population. A total of

30 subjects were included in the analysis.

METHODS

Patient record search of note titles for falls was compiled daily. A random sample of 170 veterans who had experienced a fall was screened for study inclusion. Of the 170 charts, data from a total of 120 veterans who experienced a documented fall during a hospitalization between October 1, 2010 and October 31, 2012, were included in this analysis.

Eligibility Criteria and Baseline Characteristics

Chart reviews of veterans aged > 18 years experiencing a fall while hospitalized at the LSCVAMC between October 1, 2010 and October 31, 2012, were eligible to be included in this study. Each veteran needed to have 1 documented weight in a maximum of 24 months before the first fall and a minimum of 1 documented Hgb value prior to the first fall.

Patients were excluded if they had experienced a cerebrovascular accident or transient ischemic attack; a documented orthopedic fracture in the 12 months before the first fall; a documented amputation of a lower limb in the past 24 months; diagnosis of blindness; a lack of outpatient

weight for greater than 24 months before the first fall; a history of volume overload, renal, cardiovascular, or other in nature during hospitalization; and alcoholism. Additionally, if any of the study investigators felt as though a patient had commorities that made weight history inaccurate, those patients were excluded.

Data were reviewed on 170 randomly selected subjects. A total of 50 subjects were excluded for not meeting the inclusion criteria; 120 individuals met eligible criteria. The patients who had experienced falls were divided into 2 groups: single-event fallers (1 fall documented during the study period) and recurrent fallers (2 or more falls documented during the study period). Fifty subjects were excluded from the final analysis because they met the following exclusion criteria: volume overload anytime in the 12 months before the documented fall (42); amputation of a lower limb before the fall (6); and prosthetic device alteration within the 12 months before the fall (3). One of the subjects was eliminated for both volume overload and amputation.

Data Collection

Data obtained from the Computerized Patient Record System review included age, gender, diagnosis, and body weight at the time of the

first fall and 1 month, 3 months, 6 months, and 1 year before the first fall. Hemoglobin values at time of the first fall, 1 month, 3 months, 6 months, and 1 year before first documented fall also were collected. Vitamin D values and date of value also were collected. In year 2 of this multiphase retrospective review, charts again were reviewed and additional data collected, which included absence or presence of dementia along with type of dementia and the presence or absence of cancer. Year 2 data collection also included diagnosis of malnutrition by provider and registered dietitian assessment of degree of malnutrition.

Analysis

Data analysis comparing single-event fallers and frequent fallers was performed using IBM SPSS Statistic V22.0s. This pilot study has recognized weight loss and anemia as being associated with repeat falls. A 2-tailed *t* test was performed to evaluate differences in weight history, 25-hydroxyvitamin D, and Hgb characteristics between single fallers and frequent fallers. A repeated analysis of variance was performed to evaluate changes in weight and Hgb values over time for single and multiple falls. During phase 2 of this trial, a subanalysis comparing individuals with and without the diagnosis of dementia was conducted.

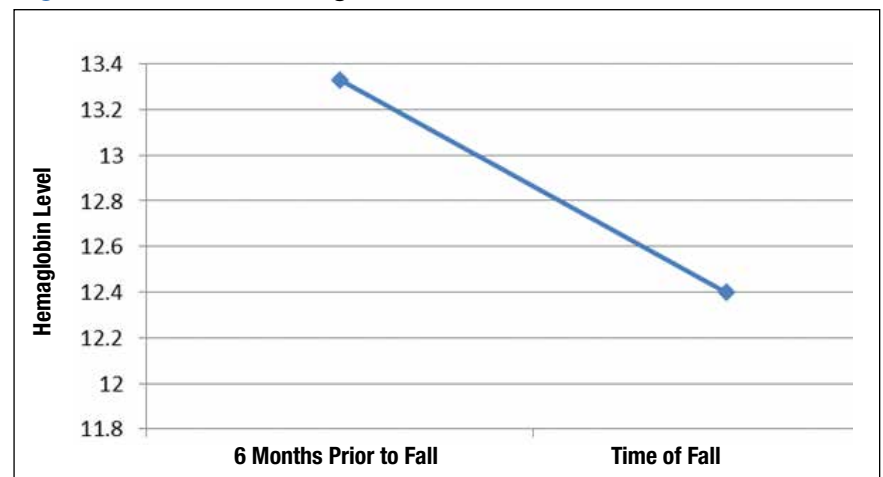
RESULTS

The average age of the patients was 68 years. There was a significant decline in Hgb levels in both single-event fallers and frequent fallers at 12 and 6 months before the first fall event (95% confidence interval; $P = .001$). One year before the first fall, 28% of eventual fallers met WHO criteria for the diagnosis of mild anemia. One year before the

Table 2. Frequency of Dementia Patients Who Have Fallen (N = 30)

	Single Fallers (%)	Multiple Fallers (%)
Fallers with malnutrition	0 (0%)	8 (100%)
Fallers without malnutrition	11 (50%)	11 (50%)

Figure. Decline in Hemoglobin Values for All Fallers



first fall, none of the eventual fallers met WHO criteria for moderate or severe anemia. Using the lab data just before the first fall, 10% of fallers met WHO criteria for mild anemia, 48% met WHO criteria for moderate anemia, and 31% met WHO criteria for severe anemia. The degree of anemia in single-event fallers when compared with multiple-event fallers was insignificant. Interestingly, the degree of decline of Hgb value during the 6 months before the first fall event was notable for all fallers (Figure).

Only 60 of the 120 included patients had a documented vitamin D level. At the time of the fall, 46 patients had moderate vitamin D deficiency, and 23 patients had severe vitamin D deficiency, defined as < 32 mg/dL. The authors speculate that vitamin D status declines with

malnutrition and increases fall risk.

Thirty participants were included in the dementia arm; 36.7% were single-event fallers, and 63.3% were multiple-event fallers (Table 2). The average age of the groups was 76.7 years and 73.9 years, respectively. Physician diagnosis of malnutrition was collected for both single- and multiple-event fallers. Of the single-event fallers with dementia, none had a diagnosis of malnutrition before the first hospital fall; and of the multiple-event fallers with dementia, all had a diagnosis of malnutrition before their first hospital fall. Individuals with a diagnosis of dementia and malnutrition fall frequently ($P = .0028$).

DISCUSSION

In this study, falls occurred in a variety of patient populations. Both

single-event fallers and recurrent fallers had a significant drop in Hgb values at 12, 6, and 3 months before the first fall. There was not a strong difference of the Hgb value between single-event falls and multiple fallers in the total population. Anemia was a significant risk factor for all fallers. The decline in the Hgb level before a fall is highly predictive of fall risk.

In individuals with dementia, those with the diagnosis of malnutrition are frequent fallers. A tool to assist in identification of this patient population along with a focused intervention strategy for this population is an area of needed research.

Further research is under way to determine which components of malnutrition diagnosis contribute to fall risk. If so, development of a fall assessment tool, including various components of malnutrition is warranted. Intervention strategies to reduce fall risk may soon include new nutrition and education techniques based on the faller constellation. Falls instruments that explore nutritional risk factors and falls should be investigated (ie, weight loss, vitamin D status, and anemia).

Falls occur in patients with a variety of risk factors (eg, mobility and cognition). The current screening instruments to assess fall risk factors do not sufficiently account for nutritional risk factors. In the Eat Well, Fall Less Study of hospitalized veterans, nutritional risk factors of anemia and weight loss also were associated with single- and multiple-event fallers. The AUTUMN falls instrument that includes critical elements of malnutrition, such as a decline in Hgb and weight loss, is currently being created and is in the process of being validated at LSCVAMC; this tool will incorporate components of malnutrition. ●

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