Online Exclusive Article

Do Older Adults With Cancer Fall More Often? A Comparative Analysis of Falls in Those With and Without Cancer

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Purpose/Objectives: To examine whether a history of cancer increased the likelihood of a fall in community-dwelling older adults, and if cancer type, stage, or time since diagnosis increased falls.

Design: A longitudinal, retrospective, cohort study.

Setting: A home- and community-based waiver program in Michigan.

Sample: 862 older adults aged 65 years or older with cancer compared to 8,617 older adults without cancer using data from the Minimum Data Set-Home Care and Michigan cancer registry.

Methods: Reports of falls were examined for 90–180 days. Generalized estimating equations were used to compare differences between the groups.

Main Research Variables: Cancer, falls, patient characteristics, comorbidities, medications, pain, weight loss, vision, memory recall, and activities, as well as cancer type, stage, and time since diagnosis.

Findings: A fall occurred at a rate of 33% in older adults with cancer compared to 29% without cancer ($p < 0.00$). Those with a history of cancer were more likely to fall than those without cancer (adjusted odds ratio 1.16; 95% confidence interval [1.02, 1.33]; $p = 0.03$). No differences in fall rates were determined by cancer type or stage, and the odds of a fall did not increase when adding time since cancer diagnosis.

Conclusions: The fall rate was higher in older adults with cancer than in older adults without cancer.

Implications for Nursing: Nurses need to assess fall risk and initiate fall prevention measures for older adults at the time of cancer diagnosis.

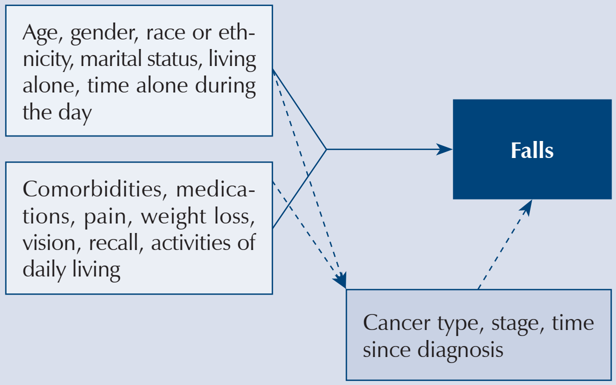
Knowledge Translation: When caring for older adults with cancer, nurses should be aware of an increased risk for falls. Healthcare staff also should be aware of an increased risk for falls in that population during cancer treatment. Evidence-based fall prevention measures should be included in care plans for older adult cancer survivors.

As the age of the general population increases, significant growth will occur in the number of older adults who have had cancer and may suffer from the impact of the disease or its treatment through the end of life (National Cancer Institute, 2013). The various effects of cancer or treatment may appear months or even years after treatment has ended (Blaauwbroek et al., 2007; Fox & Lyon, 2007; Hawkins et al., 2008); therefore, examining the association between cancer history and an adverse outcome such as a fall is important so that clinicians can implement prevention strategies, if needed. Although the literature has given attention to falls (Mohile et al., 2011; Overcash, 2007), few studies have examined whether cancer diagnoses alter fall rates in older adult survivors compared to a like group of older adults without cancer.

The research team previously had described the prevalence of falls in older adults with cancer (Spoelstra, Given, von Eye, & Given, 2010a, 2010b). The current study extends that work by examining falls over a longer period of time so that more refined comparisons can be made between those with and without cancer and identifying whether fall rates vary by cancer type, stage, or time since cancer diagnosis.

Conceptual Framework

The selection of variables for the current study was guided by a synthesis of the Life-Course Model of Aging (Freedman, Martin, Schoeni, & Cornman, 2008) and the Health-Related Quality of Life model (Ferrans, Zerwic, Wilbur, & Larson, 2005) (see Figure 1). The Life-Course model directed examination of items such as disability in activities of daily living (ADLs), and the Health-Related Quality of Life model directed examination of biologic factors. The current framework synthesized factors from the two models to determine how characteristics and biologic or environmental factors influenced falls. The researchers expected that falls would be more prevalent among those with cancer, particularly in certain types of cancer, later stages of cancer, or more recently diagnosed older adults.



Note. Solid lines indicate factors influencing falls; dashed lines indicate the mediating influence of cancer on falls.

Figure 1. Framework for the Study of Falls in Older Adults With Cancer

Note. Based on information from Ferrans et al., 2005; Freedman et al., 2008.

Literature Review

Falls already are prevalent in older adults; 30% of those aged 65 years or older experience a fall each year (Gillespie et al., 2012). Factors such as advanced age, Caucasian race, male gender, dementia, visual disturbance, muscle weakness, urinary incontinence, impaired balance, syncope, polypharmacy, and psychotropic medications are known to lead to increased fall rates in older adults (Tinetti, Allore, Araujo, & Seeman, 2005). In addition, older adults often have multiple comorbid conditions that may exacerbate frailty and functional decline, leading to increased rates of falls (Fried, Ferrucci, Darer, Williamson, & Anderson, 2004; Guilley et al., 2008).

Fall Rates in Patients With Cancer

The literature has revealed evidence of an association between cancer diagnoses and falls. Mohile et al. (2011) examined 22,349 Medicare beneficiaries and compared fall rates in those with and without cancer. Findings indicated that an increased fall rate odds ratio (OR) of 1.17 (95% confidence interval [CI] [1.04, 1.32]) occurred. Chen et al. (2009) examined falls after individuals were diagnosed with breast cancer and found a hazard ratio (HR) of 1.27 (95% CI [1.18, 1.36]) compared to an HR of 1.15 (95% CI [1.06, 1.25]) of falling for other cancers.

Conversely, Overcash and Beckstead (2008) examined fall rates in 352 community-dwelling older adults and found lower fall rates in those with cancer when compared to a like sample. The like group (n = 55) had the highest rate of falls at 42%, followed by 33% in those with cancer who were in treatment (n = 86), and 25% in those with cancer who were not in treatment (n = 211) (Overcash & Beckstead, 2008). In that study, participants' other comorbid conditions were not considered. Similarly, Spoelstra et al. (2010b) did not find a higher rate of falls in those with cancer compared to a like group without cancer. Findings are in conflict and more study is needed.

Age, gender, and race or ethnicity: Older adults with cancer likely have similar factors associated with falls as all older adults; however, that is not known for certain. A review of seven studies that focused on fall risk factors in patients with cancer found significant methodologic limitations precluding synthesis of the findings, such as unsuitability of cross-sectional study design causing difficulty with determining whether observed impairments in functioning have predisposed falling or resulted from it (Stone, Lawlor, & Kenny, 2011). In general, age, gender, and race are associated with falls (Spoelstra et al., 2010b). However, age did not influence fall rates when examining community-dwelling older adult patients with cancer (Overcash & Beckstead, 2008). Male gender often is associated with certain types of cancer, such as prostate, and seemed to increase falls in those with a cancer diagnosis (Alibhai et al., 2010; Chen, Kenefick, Tang, & McCorkle, 2004). No reports were found on race or ethnicity relating to falls in those with cancer, and additional study is needed.

Type, stage, or time since diagnosis: Evidence is limited about the relationship between falls and cancer type, stage, or time since diagnosis. However, certain treatments for prostate cancer, such as androgen-deprivation therapy, had long-term effects on functional decline, increasing the prevalence of falls (Alibhai et al., 2010; Bylow, Mohile, Stadler, & Dale, 2007). Mohile et al. (2011) found that patients with prostate (OR 1.25; 95% CI [1.1, 1.57]) or cervical and uterine cancers (OR 1.46; 95% CI [1.1, 1.92]) were more likely to fall than those with other types of cancer.

A retrospective study showed that patients who are postmenopausal with breast cancer have a higher risk of early bone loss, which may lead to increased fall rates (Waltman et al., 2006). More evidence of functional impairment exists in patients with early-stage and metastatic breast cancer, which also may increase the occurrence of falls (Cheville, Troxel, Basford, & Kornblith, 2008; DeSanto-Madeya, Bauer-Wu, & Gross, 2007; Mandelblatt et al., 2006). Overcash et al. (2007) recommended comparing fall rates of patients with cancer who are in treatment to fall rates of patients not in treatment; however, no studies to date have examined this. Although the rate of falls may be higher for patients more recently diagnosed with cancer, with certain types of cancer, or in later stages of cancer, whether those factors or comorbidities increase fall rates still is not known.

Function, cognition, and symptoms: Overcash (2007) suggested that ADLs do not influence falls in those with cancer. In contrast, van Helden et al. (2008) suggested that impairments in ADLs are risk factors for falls in community-dwelling older adults. Multiple studies demonstrated how certain symptoms or factors related to cancer or treatment influence functional decline, specifically cancer-related fatigue and pain, which may lead to falls (Barsevick, Dudley, & Beck, 2006; Deimling, Bowman, & Wagner, 2007). Falls also may be influenced by other cancer-related conditions associated with functional decline such as neurotoxicity, fatigue, depression, impaired cognitive function, pain, gait and balance problems, loss of bone density, weight loss, and vitamin D deficiency (Deimling, Bowman, et al., 2007; Holley, 2002; Limburg, 2007; Luctkar-Flude, Groll, Tranmer, & Woodend, 2007; O'Connell, Baker, Gaskin, & Hawkins, 2007; Overcash, 2007, 2008; Visovsky, 2006).

Using that literature and the research frameworks, the current researchers examined whether community-dwelling older adults with cancer had a higher rate of falls than community-dwelling older adults without cancer. Whether specific types and stages of cancer or time since diagnoses increased the likelihood of having a fall also was examined.

Methods

The retrospective, longitudinal study compared individuals with cancer to those without cancer. The sample included adults aged 65 years or older enrolled in a home- and community-based service (HCBS) program. The current study examined the first two assessments administered from 2002–2007 (Landi et al., 2000). All types of cancer diagnoses were included with the exception of skin cancer. After consideration and review of the literature, skin cancer was excluded because most are not treated or terminal (American Cancer Society, 2008; Anderson, Kish, & Cornell, 1978). Older adults enrolled in health maintenance organizations were excluded as they may have received different types of services at home. Patients who died within two months of their cancer diagnosis also were excluded.

The selection of variables was guided by empirical literature on falls in older adults. Characteristics of age, gender, race and ethnicity, marital status, living alone, and time alone during the day were included, as well as certain medications (hypnotics, antidepressants, antipsychotics, and anti-anxiety), cognition, vision, weight loss, pain, comorbidities, and ADLs. The current researchers focused on older adults with cancer who were diagnosed no earlier than the year 2000 and investigated the occurrence of falls since time of cancer diagnosis, as well as by cancer type and stage. A data-use agreement was initiated with the Michigan Department of Community Health, and institutional review board approval was obtained.

Setting and Sample

The sample was made up of dually eligible Medicare and Medicaid recipients in an HCBS waiver covered under the Social Security Act in the state of Michigan (LeBlanc, Tonner, & Harrington, 2000). To be eligible for the HCBS program in Michigan, individuals met Medicaid-defined nursing facility level-of-care criteria, including a need for assistance with basic and instrumental ADLs, annual income at or below 300% of the

Table 1. Sample Characteristics by Fall and Cancer Status (N = 9,481)

	With Falls				Without Falls			
	Cancer (n = 273)		Noncancer (n = 2,790)		Cancer (n = 591)		Noncancer (n = 5,827)	
Characteristic	n	%	n	%	n	%	n	%
Gender								
Female	177	65	1,827	65	318	54	4,080	70
Male	94	34	815	29	231	39	1,636	28
Missing data	2	1	148	6	42	7	111	2
Race or ethnicity								
Caucasian	200	73	2,114	76	422	71	4,226	73
African American	64	23	495	18	131	22	1,425	24
Other	9	4	105	4	20	4	121	2
Missing data	–	–	76	1	18	3	55	1
Marital status								
Married	55	20	566	20	95	16	1,022	18
Widowed	124	45	1,127	40	225	38	2,613	45
Other	48	18	399	14	90	15	905	15
Missing data	46	17	698	26	181	31	1,287	22
Lives with someone								
No	122	45	2,358	85	210	36	5,346	92
Yes	151	55	307	11	363	61	445	7
Missing data	–	–	125	4	18	3	36	1
Time alone during the day								
Never	134	49	998	36	192	32	2,119	36
One hour	24	9	322	12	60	10	675	12
Long periods	75	27	823	30	195	33	1,913	33
All the time	40	15	551	20	117	20	1,119	19
Missing data	–	–	96	2	27	5	1	< 1

Note. Based on information from Landi et al., 2000.
Note. Because of rounding, not all percentages total 100.

Table 2. Comorbidities and Symptoms by Fall and Cancer Status (N = 9,481)

Variable	With Falls: Cancer (n = 273) n	%	With Falls: Noncancer (n = 2,790) n	%	Without Falls: Cancer (n = 591) n	%	Without Falls: Noncancer (n = 5,827) n	%
Arthritis								
No	215	79	743	26	426	72	1,512	26
Yes	57	21	1,942	70	141	24	4,286	74
Missing data	1	< 1	105	4	24	4	29	< 1
Congestive heart failure								
No	177	65	1,649	59	365	61	3,615	62
Yes	96	35	1,035	37	199	34	2,181	37
Missing data	–	–	106	4	27	5	31	1
Coronary artery disease								
No	173	63	1,706	61	379	65	3,836	66
Yes	100	37	968	35	180	30	1,936	33
Missing data	–	–	116	4	32	5	55	1
Depression								
No	140	51	1,384	50	366	62	3,572	62
Yes	133	49	1,282	46	200	34	2,227	38
Missing data	–	–	124	4	25	4	28	< 1
Diabetes								
No	155	57	1,520	55	317	54	3,420	59
Yes	118	43	1,175	42	225	38	2,395	41
Missing data	–	–	95	3	49	8	12	< 1
Evidence of pain								
No pain	43	16	572	21	131	22	1,570	27
Less than daily	58	21	568	20	138	23	1,263	21
Daily	172	63	1,582	57	287	49	2,994	52
Missing data	–	–	68	2	35	6	–	–
Incontinence								
Continent to usually continent	160	58	1,481	53	366	62	3,574	61
Occasionally to usually incontinent	112	42	1,208	43	199	34	2,244	39
Missing data	1	< 1	101	4	26	4	9	< 1
Short-term memory								
Okay	109	40	1,142	41	324	55	2,927	50
Cognitively impaired	164	60	1,565	56	244	41	2,900	50
Missing data	–	–	83	3	23	4	–	–
Stroke								
No	214	78	1,794	63	415	70	4,027	70
Yes	58	21	881	32	151	26	1,754	29
Missing data	1	< 1	115	4	25	4	46	1
Vision								
None to slight impairment	251	92	2,314	83	488	83	5,058	87
Moderate to severe impairment	22	8	362	13	72	12	759	13
Missing data	–	–	114	4	31	5	10	< 1
Weight loss								
No	213	78	2,434	87	473	80	5,500	94
Yes	60	22	253	9	88	15	323	6
Missing data	–	–	103	4	30	5	4	< 1

Note. Based on information from Landi et al., 2000.

Note. Because of rounding, not all percentages total 100.

federal poverty level, and a caregiver who provides assistance. The intent of the HCBS program is to help individuals avoid institutionalization and remain living in the community (LeBlanc et al., 2000).

After applying inclusion criteria to the original sample (N = 18,272), patients with skin cancer (n = 46), patients who only had one Minimum Data Set-Home Care (MDS-HC) assessment (n = 5,954), patients diagnosed with cancer prior to 2000 (n = 730), and patients who died within two months of their cancer diagnosis (n = 79) were eliminated from the current sample. Next, patients with and without cancer were matched based on age, gender, and race or ethnicity, and cases were removed (n = 1,982), which increased likeness of the groups for comparison. Matching is a statistical technique that leads to removal of some biases in observational studies (Kupper, Karon, Kleinbaum, Morgenstern, & Lewis, 1981; Rubin, 1973). The final sample (N = 9,481) was a 10:1 match of 864 older adults with cancer to 8,617 older adults without cancer, ample for descriptive research (Hewitt, Rowland, & Yancik, 2003; Yabroff et al., 2007).

Data Sources

Data from the MDS-HC and the Michigan cancer registry were linked from January 1, 2002, through December 31, 2007. The MDS-HC is a person-centered assessment with uniform standards for the collection of essential nursing data to inform and guide comprehensive service planning and care for community-dwelling older adults (LeBlanc et al., 2000). The MDS-HC assessment is a combination of self-report by patients and clinical validation from RNs or social workers. It is collected in person at the home after entering the program and again every 90–180 days. The MDS-HC validity and reliability were reported in an international trial (kappa = 0.74) and have been tested with much of the work completed in Michigan (Landi et al., 2000; Morris et al., 1997). Candidate predictor variables obtained from the MDS-HC included age, gender, race or ethnicity, physical and cognitive function, comorbidities, pain, weight loss, vision, and falls. A low rate of missing data (2%) from the MDS-HC did not require imputation in the current study (Zeger, Liang, & Albert, 1988).

The Michigan cancer registry is the second data source. Data are collected by the state and reported to the National Program of Cancer Registries (sensitivity 95%, specificity 98%) (Malin et al., 2002; Webster, Supramaniam, O'Connell, Chapman, & Craig, 2010). Information obtained from the cancer registry included cancer type, stage, and date of diagnosis.

Measures

MDS-HC variables were recategorized to fewer groupings for the current analysis. Age was entered in the model as a continuous variable. Presence of the six common comorbidities were coded as 0 (no) or 1 (yes), and answers were compiled in a simple count that ranged from 0 (none) to 6 (all). Evidence of pain was coded as no pain, pain less than daily, or pain daily. The measurement of short-term memory recall after five minutes on the MDS-HC was based on an instrument developed by Morris et al. (1994), which includes scores of 1 (okay) to 2 (a problem); a score of 2 was considered cognitively impaired. The scores for five ADLs were coded as 0 (independent), 1 (supervision), 2 (limited assistance), 3 (extensive assistance), 4 (total dependence), or 5 (activity did not occur) on the MDS-HC, for which reliability and scalar properties have been tested (Landi et al., 2000). Exploratory and confirmatory factor analyses were conducted on ADL variables, and a decision was made to sum ADLs as one variable ranging from 0–25, with dependent defined as those with a score of 10 or higher. Weight loss was coded as yes (1) or no (0); vision impairment was coded as none to slight impairment (2) or moderate to severe impairment (1). Incontinence was coded as continent to usually continent (1) or occasionally to usually incontinent (2). Depression was coded as yes (1) or no (0).

The primary outcome of interest was fall rate. The researchers examined if the number of falls made a difference in the analysis and found no differences whether one fall or multiple falls occurred. Therefore, the fall variable was condensed to yes (1) or no (0). Types of cancer were categorized as breast, colon, prostate, lung, or other. Cancer stage was coded as I–IV. Time since cancer diagnosis was the number of days since diagnosis date to current assessment date, a continuous variable.

Statistical Methods

SAS, version 9.1, was used to obtain descriptive statistics and build models from generalized estimating equations (GEEs). GEEs are well suited for binary and longitudinal data analyses because they conduct correlation without explicitly defining the model for the origin of the dependency. GEEs are suitable when random effects and their variances are not of direct interest (Ballinger, 2004). Because of the large sample, even small effects are detectible as statistically significant using GEEs (Cohen, 1988). Statistics were based on robust empirical estimators in the GEE models (Ballinger, 2004).

For the current study, a GEE model was built with additive effects that identified factors associated with falls in the sample over time. The sample's OR and 95% CI were derived from the GEE model. All covariates were entered in the first model with the exception of time since cancer diagnosis, and backward elimination of variables was performed. The variable with the highest p value was removed if it was not significant, and its removal did not change the estimates of other effects. That process was repeated until the final model was obtained. To explore whether variation in falls occurred in cancer type, stage, or time since cancer diagnosis, the following statistical model was implemented: The

Table 3. Medications Taken by Fall and Cancer Status (N = 9,481)

	With Falls				Without Falls			
	Cancer (n = 273)		Noncancer (n = 2,790)		Cancer (n = 591)		Noncancer (n = 5,827)	
Medication	n	%	n	%	n	%	n	%
Anti-anxiety								
None	215	79	2,059	74	442	74	4,601	79
≥ 1	58	21	595	21	112	20	1,197	21
Missing data	–	–	136	5	37	6	29	< 1
Antidepressants								
None	159	58	1,487	54	391	67	3,819	66
≥ 1	113	42	1,181	42	168	28	1,985	34
Missing data	1	< 1	122	4	32	5	23	< 1
Antipsychotics								
None	249	91	2,401	86	533	91	5,147	88
≥ 1	24	9	245	9	20	3	680	12
Missing data	–	–	144	5	38	6	–	–
Hypnotics								
None	246	90	2,375	85	501	85	5,306	91
≥ 1	27	10	61	2	50	8	473	8
Missing data	–	–	354	13	40	7	48	1

Note. Based on information from Landi et al., 2000.

Note. Because of rounding, not all percentages total 100.

Table 4. Activities of Daily Living Reported by Fall and Cancer Status (N = 9,481)

	With Falls				Without Falls			
	Cancer (n = 273)		Noncancer (n = 2,790)		Cancer (n = 591)		Noncancer (n = 5,827)	
Activity	n	%	n	%	n	%	n	%
Bathing								
Independent to some supervision	34	13	596	22	165	28	1,324	22
Limited assistance	238	87	2,104	75	402	68	4,423	76
Missing data	1	< 1	90	3	24	4	80	2
Dressing								
Independent to some supervision	131	48	1,410	51	330	56	3,235	56
Limited assistance	142	52	1,260	45	230	39	2,559	44
Missing data	–	–	120	4	31	5	33	< 1
Toilet use								
Independent to some supervision	164	60	1,702	61	405	68	3,796	66
Limited assistance to dependent	98	36	946	34	158	27	1,947	33
Missing data	11	4	142	5	28	5	84	1
Transferring								
Independent to some supervision	157	58	1,625	58	384	65	3,791	65
Limited assistance to dependent	116	42	1,048	38	168	28	1,986	34
Missing data	–	–	117	4	39	7	50	1
Walking								
Independent to some supervision	13	5	303	11	99	16	848	15
Limited assistance to dependent	260	95	2,405	86	464	79	4,879	85
Missing data	–	–	82	3	28	5	100	1

Note. Based on information from Landi et al., 2000.
Note. Because of rounding, not all percentages total 100.

outcome variable was falls, and explanatory variables included with or without cancer, cancer type, and covariates (e.g., ADLs, vision, weight loss, medications). To examine variation of falls by cancer stage, a similar statistical model was implemented: The outcome variable was falls, and explanatory variables included with or without cancer, cancer stage, and covariates (e.g., ADLs, vision, weight loss, medications). To examine variation of falls by time since cancer diagnosis in number of days (0 for those without cancer), a model using all covariates was developed to include number of days since cancer diagnosis. The procedure for backward elimination of variables was used.

Findings

The proportions of patients for each variable in the current study are presented in four categories: (a) older adults with cancer and with falls; (b) older adults with cancer and without falls; (c) older adults without cancer and with falls; and (d) older adults without cancer and without falls. Chi-square was used to examine differences among groups. A total of 9,481 community-dwelling older adults aged 65 and older were examined. Mean age of the cancer group and the noncancer group was 77 years (SD = 7.53 and SD = 6.57, respectively), and most adults were Caucasian (see Table 1). After matching, mean age and race among the groups were comparable. However, the sample had more women than men. Therefore, matching on gender was slightly imbalanced with more men diagnosed with cancer than women. In the current sample, 89% (n = 8,504) of the patients had a comorbid condition. Older adults with cancer had similar rates of diabetes, congestive heart failure, coronary artery disease, and depression as those without cancer; however, stroke and arthritis occurred more often in those without cancer (see Table 2).

The fall rate among older adults with cancer was 33% (n = 273) compared to 30% (n = 2,790) in those without cancer, a significant difference ($p = 0.01$). In older adults with cancer (n = 864), 64% had solid tumors and 93% were stage 2 or later. The most common type of cancer was breast (n = 179, 21%), followed by colon (n = 144, 17%), prostate (n = 119, 14%), and lung (n = 113, 13%), with the remaining grouped as other (n = 309, 36%). Fall occurrence varied by cancer stage ($p = 0.00$), and the number of falls was higher for those with stage II–IV cancer ($p = 0.00$) than for stage I. Older adults who experienced weight loss problems (5% or more in 30 days or 10% or more in 180 days) and had cancer were more likely to fall compared to those without cancer. A higher rate of falls was found in those with cancer who had daily pain compared to those without cancer who had daily pain. More cognitive impairment was found in patients who fall without cancer compared to those with cancer.

Findings indicate that older adults with cancer were more likely to fall compared to those without cancer. Other factors retained in the final model are that men were more likely to fall compared to women, and African Americans were less likely to fall compared to other races. Those who took antidepressants, had short-term memory recall problems, had pain daily, and experienced

Table 5. Factors Associated With Falls in the Final Generalized Estimating Equation Model

Variable	Odds Ratio	95% Confidence Interval	p
Cancer (versus no cancer)	1.16	[1.01, 1.33]	0.03
Male (versus female)	1.12	[1.03, 1.22]	1.01
African American (versus other)	0.76	[0.61, 0.96]	0.02
Antidepressant (versus none)	1.29	[1.19, 1.4]	< 0.00
Memory recall (versus no problem)	1.53	[1.41, 1.65]	< 0.00
Pain less than daily (versus no pain)	1.21	[1.08, 1.36]	< 0.00
Pain daily (versus no pain)	1.44	[1.32, 1.59]	< 0.00
Weight loss (versus none)	1.56	[1.37, 1.77]	< 0.00
Comorbidity (versus none)	1.07	[1.04, 1.12]	< 0.00

weight loss or additional comorbidities also were more likely to fall (see Tables 3–5).

To determine whether variations in falls occurred by cancer type, stage, or time since cancer diagnosis, GEE modeling was used for each question. Type of cancer ($p > 0.05$) and cancer stage ($p > 0.05$) were not retained in the final model, and variations in fall rates by cancer type or stage were not found in the current sample. Time since cancer diagnosis remained in the final model (see Table 6); however, time since diagnosis did not increase the risk of falling in the current sample, although the p value showed significance in the large sample size. Other factors retained in the final model included cognitive impairment, weight loss, pain, and comorbidities. When one or more of those factors are combined, fall rates for older adults with more recent cancer diagnoses may be influenced.

Discussion

Age, varied ADLs, vision, antipsychotics, anti-anxiety agents, and hypnotics did not contribute to the prevalence of falls, presenting a different view from what was found in the literature (Agostini, Han, & Tinetti, 2004; Rubenstein, 2006). Yancik and Ries (2000) found that the level of functional ability, not age, influenced falls, which is consistent with the current findings. Although vision problems have been associated with falls in older adults (Tinetti, 2003), that was not true in the current sample. Antipsychotics, anti-anxiety medications, and hypnotics also did not remain in the final model, possibly because of covariance with antidepressant medication or comorbid conditions.

Contrary to the existing literature, the current evidence did not support type or stage of cancer as an influence affecting falls. Although the type and stage of the cancer were known, the current data set did not include information on cancer recurrence rate or secondary cancers, which may have made a difference in the analysis. In addition, a large proportion of the sample had similar cancer type and stage, which may have led to an inability to detect differences in fall rates based on those variables.

The findings implied that the fall rate was higher in older adults with cancer compared to a matched sample of older adults without cancer. Those findings support other studies where an increase in the occurrence of falls among cancer survivors is beginning to emerge (Hewitt et al., 2003; Keating, Nørredam, Landrum, Huskamp, & Meara, 2005; Koroukian, Murray, & Madigan, 2006). The current findings also are consistent with and support those of Mohile et al. (2011), despite different samples and measures. In that Medicare study, the likelihood of a history of cancer influencing falls was an OR 1.17 (95% CI [1.04, 1.32]) (Mohile et al., 2011).

Stevens and Sogolow (2005) demonstrated that men with cancer are more likely to have functional limitations. For example, men undergoing treatment for prostate cancer have increased functional limitations that may lead to a fall (Alibhai et al., 2010). Similar to the current findings, Agostini et al. (2004) strongly associated antidepressant medications and falls in older adults. Weight loss is a key component of frailty in older adults, and a common problem during cancer treatment and later stages of cancer (Agostini et al., 2004; Pautex, Herrmann, & Zulian, 2008), which supports the current findings. In addition, certain comorbid conditions such as heart disease, arthritis, diabetes, and stroke are known to increase the risk of falls (Klabunde, Harlan, & Warren, 2006; Koroukian et al., 2006; Yabroff et al., 2007).

Studies specific to cancer supported the finding that the occurrence of pain may influence functional decline and lead to a fall (Balducci & Extermann, 2000; Barsevick et al., 2006; Deimling, Sterns, Bowman, & Kahana, 2007), and Inouye, Studenski, Tinetti, and Kuchel (2007) supported the association of cognitive decline with

Table 6. Factors Associated With Falls in the Final Generalized Estimating Equation Model Adjusted for Days Since Diagnosis for Older Adults With Cancer (N = 865)

Variable	Odds Ratio	95% Confidence Interval	p
Time since diagnosis (versus none)	1	[1, 1]	0.00
Cognitive impairment (versus none)	1.47	[1.14, 1.9]	0.05
Pain daily (versus no pain)	1.47	[1.08, 2]	0.01
Weight loss (versus none)	1.81	[1.31, 2.5]	0.00
Comorbidity	1.14	[1.04, 1.27]	0.00

falls in older adults. In addition, Pautex et al. (2008) found cognitive impairment to be associated with an increased rate of falls in those with cancer.

Although evidence exists on the negative effect of chemotherapy treatment on cognitive impairment (Staat & Segatore, 2005) and functional decline (Alibhai et al., 2010), information is limited regarding the effect of cognitive impairment on long-term cancer survivors. The potential additive effects of being male and Caucasian, using antidepressants, and experiencing daily pain, weight loss, or comorbidities with a cancer diagnosis or cancer treatment may have interacted to increase falls in older adults with cancer; therefore, those patients, in particular, need fall prevention measures.

In the current sample, older adults with a more recent cancer diagnosis had a higher rate of falls than patients who were diagnosed with cancer at a later date. That may have been influenced by cognitive impairment, evidence of pain daily, weight loss, or comorbidities. Effect size changes were not detected until removal of race or ethnicity and gender when examining time since diagnosis. Therefore, time since cancer diagnosis may be influenced by recovery from treatment, treatment-related side effects, and how the disease or treatment affected function. Results in the current analysis provide useful information for clinicians regarding time since cancer diagnosis and higher fall rates.

Limitations

Recall bias was a potential limitation in the current study because older adults may have had difficulty remembering falls, resulting in underreporting. However, the analysis included cognition as a time-varying covariate in each sample group to ensure underreporting was similar in older adults with cancer and older adults without cancer. Patients who died within two months of diagnosis were excluded from the sample, which may have underrepresented advanced-stage cancers. The unknown severity of comorbidities and influence of cancer treatment on cognition may have occurred, but no opportunity existed to control for those limitations in the secondary data analysis. Types and dates of cancer treatment also were not reported. The researchers were working with a homogeneous sample, as many of the individuals in the study had similar comorbidities and levels of function. In some instances, statistical differences were found between older adults with cancer and those without cancer, and in other instances, no differences were detected; however, those findings were derived from data with a small range and low variance, as the majority of HCBS participants had similar diminished health status. That homogeneity limited the ability to detect statistical differences in effect size for certain variables. Therefore, additional study is needed.

Implications for Future Nursing Research

Prospective studies need to be conducted to determine which factors may influence falls in older adults with cancer and whether the factors differ from or are similar to older adults who fall. That information would provide additional guidance when designing and tailoring interventions to prevent falls in older adults with cancer. Research regarding the effect of cancer treatment on falls also may provide guidance for nurses who must work to prevent falls during the cancer treatment phase. Prospective studies need to establish the causal relationship between cancer and falls to provide a better understanding of cancer, cancer treatment, and falls.

Implications for Nursing Practice

Falls are a major concern for most older adults (Delbaere, Close, Brodaty, Sachdev, & Lord, 2010) and, based on the current findings, fall prevention should become a safety priority for nurses caring for patients with cancer in all phases of care, particularly during the time closer to diagnosis.

Cancer diagnoses may increase the likelihood of a fall, so oncology nurses need to ensure that cancer survivor care plans include fall prevention. Whether additional factors influence falls in older adults with cancer compared to older adults is unknown, but nurses need to take cancer history into account as a starting point in care when assessing fall risk in older adult patients (Kagan, 2004; Rowland & Yancik, 2006; Travis & Yahalom, 2008). Nurses also need to include evidence-based fall prevention interventions in the plan of care (Hurria et al., 2007). The concern for falls in older adults with cancer is expected to increase as the prevalence of cancer increases and the age threshold for active treatment continues to expand (Hewitt et al., 2003). Fall prevention will become a natural activity for nurses as they focus on improving care for all older adults with cancer.

Conclusions

Despite the limitations, the current study's findings support earlier evidence that the increased likelihood of older adults experiencing falls may be influenced by their history of cancer. In particular, the additive effect of being male and Caucasian, taking antidepressants, experiencing daily pain, weight loss, and comorbidities, as well as cancer types or treatments may interact to increase falls in those diagnosed with cancer. Time since cancer diagnosis also is associated with higher fall rates.

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