

Injurious Falls Among Middle Aged and Older Adults With Multiple Sclerosis

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Objective: To determine the prevalence of, and risk factors for, receiving medical attention for a recent injurious fall among middle-aged and older adults who have multiple sclerosis (MS).

Design: Survey.

Setting: United States.

Participants: Seven hundred people with MS, age 55 years or older and living in the United States, were randomly selected from the North American Research Committee on Multiple Sclerosis Registry and invited by mail to participate in the study. A total of 354 people, aged 55 to 94 years, completed the survey.

Interventions: Not applicable.

Main Outcome Measures: Participant's self-report regarding receipt of medical care for a fall-related injury (received care within the past 6mo, >6mo ago, or never).

Results: More than 50% of study participants reported injurious falls; 12%, in the 6 months before the interview. Proportional odds models were used to identify factors associated with increased odds of receiving medical attention for a fall-related injury within the past 6 months. Compared with study participants who reported receiving medical attention for a fall-related injury more than 6 months ago or never, participants who reported receiving medical attention for a fall-related injury within the past 6 months were more likely to report fear of falling (odds ratio [OR]=1.94; 95% confidence interval [CI], 1.27–2.96) and osteoporosis (OR=1.65; 95% CI, 1.03–2.62).

Conclusions: Injurious falls were commonly reported by survey participants. Findings suggest that management of fear of falling and osteoporosis are important components of comprehensive fall-injury prevention programs for people aging with MS.

Key Words: Accidental falls; Multiple sclerosis; Rehabilitation; Wounds and injuries.

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FALL-INDUCED INJURIES are one of the most common causes of restricted activity, disability, and death, especially in elderly populations.¹⁻³ Between 1992 and 2002, fall mortality rates increased in the United States among people older than 40 years of age, with the largest increases among people older than 65 years of age.³ Most fall prevention efforts target older adults (ie, people aged ≥ 65 y); however, falls among middle-aged adults (ie, people aged 45–64y) are an important source of fatal and nonfatal injuries in the United States.⁴ For example, emerging evidence suggests that falls from ladders during unpaid work are common among men in the 50- to 59-year age group and are associated with serious injury.⁵ In the workplace, fall-related injuries among employees aged greater than or equal to 55 years tend to be more severe than injuries sustained by younger workers.⁶

Among older adults, the problem of falls stems from a combination of high incidence and high susceptibility to trauma.⁷ Both the incidence of falls and the severity of complications stemming from a fall increase with age, level of disability, and extent of functional impairment.^{8,9} Approximately 30% of the general population of people aged 65 years or older and living in the community fall each year,^{10,11} and this proportion increases to 50% among people aged 75 years and older.^{12,13} In comparison, approximately 50% of middle-aged and older adults with multiple sclerosis (MS) have fallen in the past 6 months.^{14,15}

MS is a chronic, frequently progressive inflammatory disease of the central nervous system that is typically diagnosed among people between the ages of 20 and 50 years.¹⁶ MS is most common among people living in the northern latitudes, those who are of northern European ancestry, and women. Prevalence estimates for MS vary from 20 to 150 cases per 100,000 people, depending on the population under study and the geographic region of the world.¹⁷⁻¹⁹ In the United States, 45% of people with MS are 56 years of age or older.²⁰

Several factors may place people with MS at high risk for injurious falls. Many common MS symptoms, such as balance or gait impairment, visual impairment, and cognitive impairment, are known risk factors for injurious falls among disabled and nondisabled older adults.^{12,21-25} People with MS are at higher risk for osteoporosis than are age- and sex-matched controls,²⁶ and compromised bone strength in combination with falling strongly influences fracture risk.²⁷

Koski et al²⁵ demonstrated that risk factors for major injurious falls differ among disabled and nondisabled elderly living in the community, and those investigators emphasized the need to learn about risk factors for different target groups to intervene effectively. Although risk factors for injurious falls have been studied in other populations of patients with neurologic conditions,^{28,29} such studies have not been conducted with people with MS. To meet the objectives of the U.S. Department of Health and Human Services' *Healthy People 2010* initiative,³⁰ there is a pressing need to expand current knowledge to target-reduce fall-related injuries among older adults with chronic conditions such as MS.

The aim of the present study was to advance knowledge of risk for fall-related injuries among people with MS by examining the prevalence of, and risk factors associated with, in-

creased likelihood of receiving medical attention for a recent injurious fall among middle-aged and older adults who have MS in the United States. For the purposes of this study, a recent injurious fall was defined as one that had led a person to seek medical attention from a physician, medical office, hospital emergency department, or paramedic within the past 6 months.

METHODS

The data set used in this study was originally collected to inform development of an intervention intended to reduce fall risk factors among people with MS who were aged 55 years or older.

Selection and Description of Participants

The original project was reviewed and approved by the institutional review board of the University of Illinois at Chicago, Chicago, IL. All procedures were approved for use, including contact and recruitment materials.

Participants were recruited through the North American Research Committee on Multiple Sclerosis (NARCOMS) Registry, a volunteer registry of more than 25,000 people with MS.³¹ Seven hundred people with MS who were aged 55 years or older and living in the United States were randomly selected and invited by mail to participate in the study. The decision to invite the participation of 700 people was based on the original aims of the study (ie, to inform development of a fall prevention program for people with MS by collecting information regarding fall risk factors) and on previous experience with recruitment through the NARCOMS registry. Interested people were asked to contact the study office to confirm eligibility (ie, ≥ 55 years of age, self-reported diagnosis of MS, willingness to participate in a telephone interview). The study was open to all people who met these criteria; no restrictions were placed based on location of residence (eg, community vs institution).

Of the 700 letters sent, 5 were returned because of change of address or death. A total of 384 people (55%) expressed initial interest in participating in the study, but across these people, 9 declined to participate on contact, and 6 were ineligible on screening. Across the remaining 369 people, 354 completed a full interview independently (participation rate, 51%). Fifteen people were unable to complete the full interview because of fatigue; time constraints; or cognitive impairment, which was evaluated by using the Blessed Orientation-Concentration-Memory (BOMC) test.³² These same reasons may also explain why other people with MS did not respond to the study invitation. Alternatively, it is possible that discussions about falls could raise concerns about fall risk or lead to recollection of unpleasant memories about fall-related experiences. Thus, some people may have turned down the invitation to participate in the study to avoid such conversations. A basic descriptive profile of the 354 participants who were included in the analysis of this study is provided in table 1.

Data Collection Procedures

Participants were contacted by telephone and interviewed by the principal investigator, by the co-principal investigator, or by 1 of 4 trained research assistants. Interviews lasted an average of 39 minutes (median, 35min). A structured interview guide was used to gather sociodemographic information, background about the participant's MS course, presence and extent of MS symptoms, presence of activity limitations, the use of assistive technology to aid in day-to-day tasks, availability of social support, experience of fear of falling, and falls self-efficacy.

Most of the 58 questions on the interview guide were closed-ended survey items. Wherever possible, these items were

Table 1: Basic Demographic Characteristics (N=354)

Characteristic	n	%
Age (y)*	66.8	7.1
Sex		
Male	118	33.3
Female	236	66.7
MS-related characteristics		
Years since diagnosis*	21.6	12.5
MS status in past year		
Stable or improving	125	35.4
Deteriorating	142	40.2
Variable	86	24.4
MS course over the past year		
Unpredictable	44	12.8
Mild and intermittent	102	29.6
Steady and progressive	162	47.0
Initially mild and intermittent then steady and progressive	37	10.7
No. of MS-related symptoms*	6.1	1.9
Health-related characteristics		
BOMC test score*†	2.2	2.0
No. of health conditions (excluding MS and osteoporosis)*	1.6	1.3
Housing accommodations		
Type of housing		
Independent living	324	91.5
Nursing home or assisted living facility	8	2.3
Other	22	6.2
Accessibility of the home		
Bad or poor	16	4.5
Fair	47	13.3
Good	100	28.2
Very good	191	54.0

*Indicates a continuous variable and mean and standard deviation (SD) were presented instead of frequency and percentage.

†Score range from 0 (no cognitive impairment) to 12 (severe cognitive impairment).

drawn from existing studies of falls or MS. In addition, 2 open-ended questions were asked. The first inquired about the participant's most recent fall. In the second, participants were asked whether they had ever sought any type of medical attention because of a fall-related injury. Definitions for injurious and noninjurious falls were not provided to participants as part of the interview. Participants who reported that they had received fall-related medical attention were asked follow-up questions about the nature of the injury and the care received. Information from these questions was recorded as fieldnotes in preparation for content analysis.

Data Analysis

Survey data were entered into SPSS DataBuilder^a software and then imported into SAS^b software for analysis. These data were analyzed descriptively to identify potentially invalid responses and possible data entry errors. Errors were checked and corrected against the raw data on the hard-copy interview guides.

The outcome variable for the analysis was constructed by using the participant's responses to the following 2 questions: "Have you ever needed to seek any type of medical attention or care because of a fall-related injury?" (yes, no) and (if yes) "When was the most recent time you received care for a fall-related injury?" Responses were used to create a 3-level outcome variable: never experienced an injurious fall, received

medical attention for an injurious fall more than 6 months ago, and received medical attention for an injurious fall within the past 6 months. These categories were selected to ensure cell size for analysis purposes. Given the ordinal nature of this outcome, proportional odds models were used to identify potential factors that may be associated with increased odds of experiencing a recent injurious fall.³³

Based on knowledge about falls among people with MS^{14,15} and risk factors for injurious falls among community-dwelling older adults, 12 covariates were initially considered for the analysis. These variables included: age, sex, MS status (stable or improving, deteriorating, variable), poor concentration or forgetfulness (problem, not a problem), balance or mobility (problem, not a problem), bladder control (eg, urgency, incontinence; problem, not a problem), osteoporosis (yes, no), cane and/or walker use (use, do not use), wheelchair use (use, do not use), report of taking 3 or more medications (yes, no), fall frequency (less than twice a year, each 5 to 7 weeks to twice a year, once a month or more), and fear of falling (yes, no). The a priori hypothesis was that older age, presence of osteoporosis, problems with balance and mobility, problems with concentration or forgetfulness, and greater fall frequency would be associated with increased odds of receiving medical care for an injurious fall. We were uncertain whether any other variables would be related to injurious falls and therefore assumed no relationship.

Model selection was performed on this set of 12 variables by using 3 different model selection methods: forward, backward, and a combination method using both forward and backward (ie, stepwise). For all models, a *P* value criterion of .05 was used for both entry into the model and remaining in it. The models obtained from the 3 methods were compared and found to be identical.

The use of a proportional odds model requires that the proportional odds assumption be satisfied. A score test for the proportional odds assumption on the final model resulted in a chi-square of χ^2_2 equal to 2.64 and a *P* value of .267, thus satisfying the required assumption. The deviance (*P*=.533) and Pearson (*P*=.531) goodness-of-fit tests indicated that the final model fitted the data well.

Qualitative data from the open-ended questions were recorded as fieldnotes and were analyzed by using standard content analysis techniques.³⁴ Four members of the research team independently analyzed the data and identified classifications or groupings of injury types. The analyses were compared, and when differences were found, discussions were held among those four until a consensus was reached. Frequencies were used to summarize the nature and number of injuries that were reported in each of the classifications developed through this process.

RESULTS

Description of the Sample

A general profile of the 354 participants is provided in table 1. Additional descriptive data about the participants (data not shown in table 1) indicate that their most common symptoms were problems with balance and mobility (93.7% [n=329]), leg weakness (90.9% [n=321]), fatigue (88.4% [n=311]), problems with bladder control (78.1% [n=274]), poor concentration or forgetfulness (65.2% [n=229]), problems with bowel irregularity (59.3% [n=210]), pain (56.5% [n=199]), depression (43.1% [n=152]), and problems with seeing (38.9% [n=136]). Other than MS, participants reported living with a variety of other health conditions that influenced their health and ability to manage day-to-day activities. Some of these

conditions included arthritis (37.4% [n=130]), diabetes (35.7% [n=126]), high or low blood pressure (32.9% [n=115]), visual problems (27.1% [n=95]), and heart problems (19% [n=67]).

Sixty-four percent (n=225) of the study participants reported that they experience at least 2 falls each year; 30% (n=107) reported experiencing a fall once a month or more. Among study participants who reported receiving medical care for a fall-related injury (n=177 [50%]), 41 (23%) of these people indicated that they done so in the 6 months before the interview. Descriptive details of the participants according to time of the most recent fall-related injury (ie, never, ≤6mo ago, >6mo ago) are provided in table 2. The types of injuries reported (based on open-ended questions) are shown in table 3. Fractures were the most commonly reported injury. Only 24 participants (14%) reported sustaining greater than 1 injury during their most recent injurious fall. Among those people, 1 reported greater than 1 fracture, and 2 people reported greater than 1 injury categorized as miscellaneous.

Factors Associated With Increased Likelihood of Experiencing a Recent Fall

Table 4 shows the parameter estimate, *P* values, and odds ratios (ORs) from the final proportional odds model obtained by examining factors associated with receiving medical attention for an injurious fall. The results of the analysis found only 2 factors, fear of falling (OR=1.94; 95% confidence interval [CI], 1.27–2.96) and osteoporosis (OR=1.65; 95% CI, 1.03–2.62), to be associated with increased likelihood of seeking medical attention for a fall-related injury within the past 6 months. On the basis of the findings, the hypothesis that older age, osteoporosis, problems with balance and mobility, problems with concentration or forgetfulness, and greater fall frequency would be associated with an increased likelihood of receiving care for a fall-related injury was partially accepted. Within this set of factors, only osteoporosis was significant in the final model.

DISCUSSION

This study is the first to report prevalence of and risk factors associated with receiving medical attention for an injurious fall among middle-aged and older adults who have MS. Our findings suggest an important relationship between osteoporosis and fall-related injuries among middle-aged and older adults with MS. Fear of falling, which was the only other factor associated in this study with receiving medical attention for a recent injurious fall, has not been identified as a risk factor for injurious falls in previously published cross-sectional and prospective studies involving disabled and nondisabled community-dwelling adults.

The finding that osteoporosis was associated with increased likelihood of receiving medical care for a recent injurious fall highlights the need to prevent and manage this condition among both men and women with MS. Apart from increasing risk of fracture, particularly fractures of the spine, wrist, or hip,³⁵ osteoporosis may increase fall risk in general. Li-Ambrose et al³⁶ found that compared with age-matched counterparts without osteoporosis, women with osteoporosis experienced compromised quadriceps strength and balance, both of which are established fall risk factors. Greig et al³⁷ found that vertebral fracture is associated with impaired balance in people with osteoporosis. The mechanism underlying the relationship between balance and vertebral fractures is unclear; however, it is interesting to note that people with vertebral fractures resulting from osteoporosis have an increased fear of falling,³⁸ which has been shown to affect balance control.^{39,40} Among older

Table 2: Variables Considered in the Proportional Odds Regression Modeling for the Most Recent Fall That Required Medical Attention (N=354)

Characteristic	Most Recent Fall That Required Medical Attention					
	Never (n=169 [48.8%])		>6 Months (n=136 [39.3%])		≤6 Months (n=41 [11.9%])	
	n	%	n	%	n	%
Age (y)*	67.3	7.1	66.2	7.3	67.2	6.1
Sex						
Male	70	41.4	37	27.2	11	26.8
Female	99	58.6	99	72.8	30	73.2
MS-related characteristics						
MS status in past year						
Stable or improving	66	39.3	43	31.6	11	26.8
Deteriorating	63	37.5	55	40.4	21	51.2
Variable	39	23.2	38	27.9	9	22.0
MS symptom: poor concentration or forgetfulness						
Is a problem	107	64.1	93	68.4	26	65.0
Not a problem	60	35.9	43	31.6	14	35.0
MS symptom: balance or mobility problems						
Is a problem	156	93.4	125	92.6	40	97.6
Not a problem	11	6.6	10	7.4	1	2.4
MS symptom: bladder control problems						
Is a problem	130	76.9	105	78.9	33	80.5
Not a problem	39	23.1	28	21.1	8	19.5
Health-related characteristics						
Osteoporosis status						
Yes	33	20.1	47	35.1	12	30.0
No	131	79.9	87	64.9	28	70.0
Mobility aid: cane or walker						
Use mobility aid	136	80.5	99	72.8	29	70.7
Do not use mobility aid	33	19.5	37	27.2	12	29.3
Mobility aid: manual or power wheelchair						
Use mobility aid	131	77.5	102	75.0	27	65.9
Do not use mobility aid	38	22.5	34	25.0	14	34.1
Amount of prescription medication taken						
>3	126	75.4	108	80.0	35	85.4
<3	41	24.6	27	20.0	6	14.6
Fall-related characteristics						
Fall frequency						
Less than twice a year	61	36.5	51	37.8	9	22.0
More than twice a year, but less than once a month	59	35.3	41	30.4	16	39.0
Once a month or more	47	28.1	43	31.9	16	39.0
Fear of falling						
Yes	80	47.6	83	61.0	29	70.7
No	88	52.4	53	39.0	12	29.3

NOTE. Eight participants did not provide appropriate information about their most recent fall and were thus excluded from this table and subsequent analysis.

*Indicates a continuous variable and mean and SD were presented instead of frequency and percentage.

women with low bone mass, falls self-efficacy is independently associated with measures of balance and mobility after accounting for age, current physical activity, and performance in relevant physiologic domains.⁴¹

Screening for osteoporosis is an essential step toward prevention of osteoporosis-related falls and fractures. However, osteoporosis screening practices in the United States are suboptimal. More than two thirds of cases of osteoporosis are not diagnosed,⁴² and additional barriers to osteoporosis screening exist for people with MS. Specifically, attention to basic health promotion among people with MS is often eclipsed by the narrow focus on their underlying conditions,^{43,44} and mobility limitations may interfere with utilization of dual x-ray absorptiometry at the hip, which is the technical standard for measuring bone mineral density.⁴²

The finding that fear of falling increased the likelihood of receiving medical attention for an injurious fall suggests the need to understand and manage fear of falling among people who are aging with MS. Results of this study and of studies documenting the prevalence of fear of falling among middle-aged adults living in the community highlight the importance of recognizing that fear of falling is not experienced exclusively by older adults.^{45,46}

We suspect that fear of falling is clinically relevant for people with MS because earlier work has shown that this factor is associated with increased fall risk among people with MS aged 45 to 90 years¹⁵ and can lead to activity curtailment and increased fall risk among older adults in general.⁴⁷ However, because our results were based on cross-sectional data, the direction of the relationship between fear of falling and fall-

Table 3: Type and Frequency of Fall-Related Injuries Among Adults (n=177) With MS, Aged 55 Years and Older

Type of Injury Reported	Frequency
Fracture	80
Hip	(12)
Lower extremity (other than hip)	(40)
Upper extremity	(17)
Other	(11)
Soft tissue injuries (eg, bruises, lacerations/abrasions not requiring stitches, strains, sprains, dislocations)	60
Laceration requiring stitches or staples	21
Head injury (eg, subdural hematoma, concussion, "bumped" head)	9
Other	24

NOTE. Of 177 participants with injuries, 24 reported more than 1 injury. Values in parentheses are subtotals.

related injuries among people with MS cannot be inferred through this study. It would not be unexpected for people with MS who experience a fall-related injury to develop a concern about future falls. Thus, health care providers have an important role in identifying and managing fear of falling among people with MS. Individual assessment is needed to determine whether or not fear of falling is an appropriate response to high fall risk among people with MS, as well as to determine the extent to which reported or observed activity curtailment is protective (ie, preventing involvement in activities that exceed abilities) or contributes to deconditioning and subsequent fall risk. For people who are curtailing activity due to fear of falling, initiating conversations about falls and assisting people with MS in their efforts to build social networks may positively impact activity levels.^{15,48} Randomized controlled trials involving community-dwelling older adults have demonstrated that fear of falling is modifiable.⁴⁹⁻⁵¹ Unfortunately, it is not currently clear whether middle-aged and older adults living with MS can benefit from fear-of-falling interventions. Our clinical experiences suggest that strategies to help people with MS manage fear of falling may involve both compensatory and remediative strategies. Compensatory strategies may include providing people with MS with mobility aids, modifying the home environment, and teaching energy conservation strategies. Remediative strategies may include programs to improve strength, balance, and attention span and problem-solving skills that are directed toward narrowing the gap between personal capability and activity demands.

Although fear of falling and osteoporosis were found to increase the likelihood of receiving medical attention for a recent injurious fall, 4 factors that we hypothesized would be related to this outcome were not: age, problems with balance or mobility, problems with poor concentration or forgetfulness, and frequency of falling. It is possible that age and frequency

of falling were not related to the outcome by virtue of experience. That is, people in this sample may be experienced fallers who know how to fall without sustaining an injury. It is unclear why problems with balance and mobility and with poor concentration and forgetfulness did not appear in this analysis. It may be that all of these factors fell out of the model because of inadequate power for the given sample size. This explanation is consistent with the fact that the original study was not specifically focused on identifying risk factors for injurious falls.

Study Limitations

Although this study contributes to and enhances the literature on fall risk among people with MS, it is limited by both its cross-sectional design and its self-report format. Prospective studies involving people with MS are needed to track actual falls, related injuries, and fall risk factors over time. Validating injuries against medical records or coding injuries by using measures of severity, such as the Injury Severity Score or the Modified Anatomic Profile that are based on the *International Classification of Diseases, Ninth Revision*,⁵² in future studies is also recommended. Using self-reported information about the receipt of medical care for a fall-related injury may have influenced the study's results, either through under- or over-reporting or through inaccurate descriptions of the sustained injuries. In addition to validating injuries, future studies may also benefit from adding performance-based measures of balance and the use of explicit theoretical models of health service utilization to guide the research design and analytic process, for example, the Behavioral Model of Health Service Utilization.⁵³⁻⁵⁶ Using such models would enable future researchers to incorporate factors that may predispose and enable the use of health services, such as proximity to medical care, availability of health insurance, and presence of a caregiver.

Because sample selection was drawn from a voluntary registry, we cannot be assured that our sample is representative of all adults aged 55 years and older with MS. Patients who respond to recruitment efforts associated with the NARCOMS registry may be somehow different than those who do not. In addition, it is possible that the people volunteering for this study are more or less likely to fall than is the general MS population of people aged 55 years and older. However, the demographics of the MS patients participating in the NARCOMS patient registry closely match those seen in the population-based study Portrait of MS that was completed by the National Multiple Sclerosis Society in 1993,²⁰ the New York State Registry data,⁵⁷ and the National Health Interview Survey data for MS.⁵⁸ Our sample was also comparable to samples described of people with MS who were aged 65 years or older, with respect to average age, sex distribution, most common symptoms experienced, duration of MS, and living arrangements.⁵⁹⁻⁶¹

The finding that 83% of our sample described the accessibility of their home environment as good or very good suggests that study participants may have been proactive in addressing home hazards. Alternatively, participants may have been un-

Table 4: Results From Proportional Odds Regression Modeling the Most Recent Fall That Required Medical Attention

Effect	df	Estimate	SE	χ^2	OR	95% CI for OR	P
Intercept (reference: never had an injurious fall)	2						
Had an injurious fall >6mo ago	1	-0.437	.171	6.52	NA	NA	.011
Had an injurious fall in past 6mo	1	-2.579	.230	125.73	NA	NA	<.001
Fear of falling (reference: no)	1	0.662	.216	9.37	1.94	1.27-2.96	.002
Osteoporosis status (reference: no)	1	0.498	.237	4.42	1.65	1.03-2.62	.036

Abbreviations: NA, not applicable; SE, standard error.

able to properly evaluate fall risks in the home. Altered internal standards or values associated with home accessibility may account for the high ratings. Such response shifts have been widely documented in literature describing measurement of quality of life among disabled people.⁶² Overall, our ability to assess environmental risk factors associated with fall-related injury was limited. Future studies exploring the relationship between an individual's ability to negotiate hazards in the home and his or her risk for fall-related injury are needed.

CONCLUSIONS

Our findings raise questions about the etiology of, and outcomes associated with, fall-related injuries among people with MS aged 55 years and older and highlight the need for longitudinal studies. Understanding of factors that contribute to injurious falls among specific patient populations is essential to designing effective intervention programs. Our findings suggest that among middle-aged and older adults with MS, fear of falling and osteoporosis are associated with increased likelihood of receiving medical attention for a fall-related injury within the past 6 months. Thus, management of fear of falling and osteoporosis may be important components of comprehensive fall-injury prevention programs for people who are aging with MS.

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Suppliers

- a. SPSS Inc, 233 S Wacker Dr, 11th Fl, Chicago, IL 60606.
- b. Version 9.1; SAS Institute Inc, 100 SAS Campus Dr, Cary, NC 27513.