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## The Comparative Effect of Episodes of Chiropractic and Medical Treatment on the Health of Older Adults

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### Abstract

**Objectives**—The comparative effect of chiropractic vs. medical care on health, as used in everyday practice settings by older adults, is not well understood. The purpose of this study is to examine how chiropractic compares to medical treatment in episodes of care for uncomplicated back conditions. Episode of care patterns between treatment groups are described, and effects on health outcomes among an older group of Medicare beneficiaries over a two-year period are estimated.

**Methods**—Survey data from the nationally representative Survey on Assets and Health Dynamics among the Oldest Old (AHEAD) were linked to participants' Medicare Part B claims

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#### Contributorship

**Concept development** (provided idea for the research) FDW, JH, PW, SB

**Design** (planned the methods to generate the results) PW, FDW, JH

**Supervision** (provided oversight, responsible for organization and implementation, writing of the manuscript) FDW

**Data collection/processing** (responsible for experiments, patient management, organization, or reporting data) SB, PW

**Analysis/interpretation** (responsible for statistical analysis, evaluation, and presentation of the results) PW

**Literature search** (performed the literature search) PW

**Writing** (responsible for writing a substantive part of the manuscript) PW, FDW

**Critical review** (revised manuscript for intellectual content, this does not relate to spelling and grammar checking) JH, SB

**Other** (list other specific novel contributions)

under a restricted Data Use Agreement with the Centers for Medicare and Medicaid Services. Logistic regression was used to model the effect of chiropractic use in an episode of care relative to medical treatment on declines in function and well-being among a clinically homogenous older adult population. Two analytic approaches were used, the first assumed no selection bias and the second using propensity score analyses to adjust for selection effects in the outcome models.

**Results**—Episodes of care between treatment groups varied in duration and provider visit pattern. Among the unadjusted models there was no significant difference between chiropractic and medical episodes of care. The propensity score results indicate a significant protective effect of chiropractic against declines in activities of daily living, instrumental activities of daily living, and self-rated health (AOR 0.49, AOR 0.62, and AOR 0.59, respectively). There was no difference between treatment types on declines in lower body function or depressive symptoms.

**Conclusion**—The findings from this study suggest that chiropractic use in episodes of care for uncomplicated back conditions has protective effects against declines in activities of daily living, instrumental activities of daily living, and self-rated health for older Medicare beneficiaries over a two-year period.

### Keywords

Chiropractic; Medicare; Episode of Care; Activities of Daily Living; Mobility Limitation

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## INTRODUCTION

The therapeutic and restorative benefit of chiropractic on functional abilities has been well-established in clinical efficacy studies (1–15). However, what is not known is the comparative effectiveness of chiropractic vs. other common medical treatments for similar clinical conditions over time, especially among Medicare beneficiaries receiving their care in everyday practice settings. For uncomplicated back conditions (e.g., strains and sprains, and nonspecific back disorders), Medicare patients have a variety of provider choices, including doctors of chiropractic (DCs), physical therapists, internists, neurologists, interventional pain providers, and orthopedists to name a few. Understanding which providers and treatments Medicare beneficiaries seek, how often they seek those treatments, and the effect of that care on health outcomes would inform clinicians and policy-makers alike about the comparative effectiveness of various treatments for uncomplicated back conditions provided in everyday settings.

Investigating how chiropractic care is delivered to Medicare beneficiaries in everyday practice is especially important because treatment patterns there deviate substantially from those delivered under controlled clinical trial conditions, where the intent is to prove treatment efficacy (16, 17). As a result, the health effects that a patient actually realizes from chiropractic may differ from effects observed in more controlled research settings. Furthermore, understanding how chiropractic care episodes compare to medical-care episodes on patient-reported health outcomes sheds light on whether the therapeutic benefits patients perceive is the same, better, or worse.

Functional health changes are measured by the number of limitations in activities of daily living (ADLs), in instrumental activities of daily living (IADLs), and in lower body function (LBFs), and changes in well-being are measured by self-rated health and depressive symptoms. The three functional measures are standard disability indicators, and the two well-being measures are closely associated with future functional decline, dependency, and mortality (18–25). Slowing the rate of functional decline, disability, and dependency among community-dwelling older adults reduces the threat of institutionalization and preserves autonomy and well-being, both of which are long-standing public health policy goals in the United States (26).

In this study, we use Medicare provider claims linked to a national longitudinal survey of community-dwelling older adults to examine the use of chiropractic and medical treatments in back care episodes that are comparable based on clinical presentation. The purpose of this study is twofold: to describe back care episodes in terms of visit patterns and duration among a clinically homogeneous population of older Medicare beneficiaries, and to examine whether care episodes involving chiropractic visits result in the same, better, or worse changes in functional health and well-being relative to medical-care only episodes.

## Methods

### Study Population

Survey data from the nationally representative Survey on Assets and Health Dynamics among the Oldest Old (AHEAD) were linked to participants' Medicare Part B claims under a restricted Data Use Agreement with the Centers for Medicare and Medicaid Services (27) (additional documentation concerning the AHEAD, including its objectives, survey design, and description of the data can be found elsewhere (19, 28–30)). The AHEAD survey data are rich, containing not only demographic and socioeconomic information but also details about a participant's physical and cognitive health status, disease history, and lifestyle behaviors that characterize how people age in the United States. Because the same participants were re-interviewed biennially, these data may be used to evaluate changes in older adults' health over time.

The AHEAD participants were 70 years old or older when their baseline interviews were conducted between October 1993 and February 1994. In 1995 a survey question with important implications for functional health trajectories was added to the follow-up interviews (“On average over the last 12 months have you participated in vigorous physical activity or exercise three times a week or more?”). Therefore, we used the 1995 follow-up interview as our starting point, along with the subsequent re-interviews conducted through 2006. Each pair of contiguous interviews (i.e., 1995 to 1998, 1998 to 2000, 2000 to 2002, 2002 to 2004, and 2004 to 2006) defines an observation window for this study during which an uncomplicated back condition may have occurred. To be included in the analyses, participants had to have had at least one contiguous pair of interviews between 1995 and 2006.

In 1993 there were 7,447 AHEAD participants. Of these, 774 did not provide consent to have their survey data linked to their Medicare claims, and linkage errors arose for 28

consenting participants. Another 774 participants had no follow-up interviews after baseline, either because of dying before the 1995 follow-up interview or for other reasons. Thus, the potentially available number of AHEAD participants for our study was 5,871.

### Sample Selection

To create a sample that was clinically homogenous and therefore comparable between treatments, we included only those AHEAD participants that met the following conditions. First, participants had to present to a clinician for one of twenty-nine back-related conditions (see Appendix I) in-between contiguous interviews (e.g., 1995 to 1998, 1998 to 2000, etc.). Second, participants could only have experienced one back-related episode between those contiguous interviews. Third, participants could only have one pair of contiguous interviews with a back episode over the entire study period. This resulted in a constant two-year observation window for contiguous interviews, eliminated clinical patterns suggesting more complex chronic or recurring back problems, and focused on participants having a single back condition episode that was more likely to have been acute.

Episodes of care were bounded by the first “from date” to the last “thru date” for Medicare claims having any of the diagnosis codes in Appendix I occurring consecutively within sixty days of one another. For example, if a person's index visit to a clinician occurred on March 1, and the person had a subsequent provider claim with any of the back-related diagnosis codes before May 1 of the same year, these two claims would be considered part of the same care episode. If there was a third back-related claim with a date greater than sixty days from the second claim, the third claim would be the start of a new episode. Under this algorithm, claims following in close proximity to each other were considered related, and therefore part of the same back care episode. Because studies have shown that effective chiropractic therapy for back care may require up to twelve visits over several weeks (31, 32), multiple claims occurring within 60 days of each other would suggest a therapeutic plan for a single back-problem episode rather than multiple back-problem episodes. Medical treatments for the initial presentation of a nonspecific back condition, however, typically involve only one or two visits to the primary care provider and/or imaging specialist within 60 days of each other. Thus, medical care claims for a particular back episode would likely cluster together in a shorter time frame, while chiropractic claims for discrete episodes of back problems would likely cluster together over a longer time frame.

After all of the inclusion and exclusion criteria were applied, 1,057 unique individuals experiencing only one episode of care for a back problem occurring between two contiguous interviews were identified. These 1,057 participants account for 77% of the single back-condition episodes in the data set.

### Outcome Assessment

The five health outcomes on which we compared treatments were declines between contiguous interviews in ADL, IADL, and LBF abilities, declines in self-rated health, and increased depressive symptoms. Declines over the two-year period between contiguous interviews were defined as the onset of an additional ADL, IADL, or LBF activity limitation, a 0.5 standard deviation or more poorer rating on the Diehr-transformed self-

rated health question, or the onset of additional depressive symptoms on the CES-D 8 scale (19). The five-item ADL scale includes difficulties (or the inability of) getting across a room, getting dressed, bathing or showering, eating, and getting in or out of bed. The five-item IADL scale includes difficulties (or the inability of) using a telephone, taking medication, handling money, shopping, and preparing meals. The four-item LBF scale includes difficulties (or the inability of) climbing up and down one flight of stairs, walking several blocks, pushing or pulling heavy objects, and lifting or carrying 10 or more pounds. The self-rated health question asks participants how they would rate their overall health, with response options of excellent (95), very good (90), good (80), fair (30), or poor (15). The CES-D 8 is scored as one point for each depressive symptom endorsed, including feeling depressed, feeling that everything was an effort, restless sleep, feeling happy, feeling lonely, enjoying life, feeling sad, and feeling that he/she could not get going (33). Because the CES-D 8 was only obtained for self-respondents, the analytic sample for this outcome was restricted to the 951 self-respondents.

### **Focal Variable**

The variable of interest is the type of treatment that an individual received during their back care episode. Episodes with one or more chiropractic treatments were characterized as chiropractic care episodes. Episodes without any chiropractic treatments were characterized as medical services only back-care episodes. Because our objective is to capture differential effects of chiropractic during back care episodes, chiropractic episodes could consist only of chiropractic services, or of chiropractic and medical treatments. Though this approach might lead to misclassification (heterogeneity), the number of episodes with co-occurring treatment types was assumed to be small, and the proportion of chiropractic visits within those integrated episodes was assumed to be large (17). In the final analysis each individual was classified as either having chiropractic or medical-only treatment episodes.

### **Covariates**

All models included covariates to adjust for differences in predisposing, enabling, and need characteristics identified in the behavioral model of health services use (34, 35). Predisposing characteristics included age, gender, race, and marital status. Enabling characteristics included level of education achieved, income quintiles, whether an individual had additional health insurance policies, and employment status at the time of the first interview. Need characteristics at the beginning of a contiguous pair of interviews included whether a person had three or more comorbid health conditions, ten disease history indicators, pain, vision and hearing status, physical function, self-rated health, healthy lifestyle (engaging in vigorous exercise, body mass, smoking status, and alcohol consumption), prior hospitalizations, and back care episodes during 1993–1995. Respondent status (self-respondent or proxy) at both contiguous interviews was also included to adjust for differences in source data over time. Further detail on all of these measures, including interaction terms between respondent status and functional abilities at the first of the contiguous pair of interviews, can be found in Wolinsky et al (19).

## Analysis

The comparative effectiveness of chiropractic care episodes to medical-only episodes on declines in function and well-being is assessed using multivariable logistic regression. The model is estimated in two ways. The first assumes that there was no selection bias between individuals who chose chiropractic in an episode of care vs. individuals who chose only medical care for their episode of care. The second approach uses propensity score methods to adjust for potential selection bias between individuals and their treatment choices. Modeling treatment selection yields a propensity score for each individual that reflects his or her likelihood of choosing a particular treatment type. The propensity score weighted regression models use the inverse of the estimated propensity scores to adjust the traditional population sampling weights for the AHEAD in the logistic regression analyses, taking into account each person's estimated probability of choosing a particular treatment type when modeling the outcome-treatment relationship (36–40).

The propensity score estimates,  $\hat{p}$ , were obtained by regressing the treatment group a person was in (chiropractic vs. medical-only care episodes) on all of the observable covariates at the first of the two contiguous interviews, plus several provider supply and county-level area variables shown to be predictive of chiropractic use that were available at the baseline AHEAD interview (41–44). Propensity score weights were then calculated by inverting the probability of choosing chiropractic care  $\hat{p}$  or medical-only care  $\hat{p}$  and subsequently using these weights to adjust the population sampling weights by multiplying the two weights together. The propensity score adjusted weights were then used to weight all outcome regression models.

## Human Subjects Approval

This research was supported by grants R01 AG022913 and R21 AT004578 from the National Institutes of Health (NIH) to Dr. Wolinsky. The human subject protocol was fully approved by the University of Iowa Institutional Review Board (IRB) in March 2003 and annually thereafter. A Restricted Data Agreement with the University of Michigan Survey Research Center (2003–006), and subsequent completion and approval of a Data Use Agreement with the Centers for Medicare and Medicaid Services (DUA 14807) was approved in March 2005 with subsequent modifications and extensions through 2014. Written informed consent was obtained from all AHEAD participants.

## Results

### Descriptive data

Of the 1,057 persons in the sample, 174 (16.5%) had episodes of care containing at least one visit to a DC. The mean age was 82. Thirty-three percent were men, and 89% percent were white. Thirty-eight percent had three or more comorbid health conditions, and nearly half were overweight or obese. The mean number of limitations in ADLs was 0.58 (out of five), the mean number of limitations in IADLs was 0.54 (out of five), and the mean number of limitations in LBFs was 1.39 (out of four). Sixty-two percent of the sample rated their health as good or better at their first contiguous interview, and the mean number of depressive symptoms was 1.70 (out of eight, among self-respondents). Table 1 provides means at the



first contiguous interview, and separately for chiropractic vs. medical care episodes. Significance tests illustrate major differences between treatment groups.

Demographically, a statistically greater proportion of persons having chiropractic care in their back episode were men, white, married, completed high school, and in the highest income quintile compared to those receiving only medical care during their episodes. Among those older adults choosing chiropractic, there was a lower proportion of persons with angina, and fewer ADL limitations (0.27 vs. 0.64), IADL limitations (0.28 vs. 0.60), and LBF limitations (0.99 vs. 1.48) at the first contiguous interview. Self-rated health was statistically higher in the chiropractic care group, with 71% rating their health good or better compared to 59% for those with medical-only care. Of the self-respondents in each treatment group, the mean number of endorsed depressive symptoms was lower in the chiropractic care group (1.42 vs. 1.76). Only 25% of persons in the chiropractic care group reported pain at the first of the contiguous interviews vs. 38% in the medical-only group. Of the lifestyle factors, 40% of the chiropractic care group reported engaging in vigorous exercise, relative to only 27% in the medical-only care group, yet 59% of the persons in the chiropractic group were overweight or obese relative to 47% in the medical only group. Thirty-two percent of chiropractic care users reported drinking more than one alcoholic drink per day, vs. 20% in the medical-only group. A lower proportion of chiropractic care users were hospitalized in the year prior to their first interview (30% vs. 38%), and a greater proportion were self-respondents at both interviews of the contiguous surveys (88% vs. 82%).

Table 2 summarizes the episode characteristics by treatment group, and illustrates that care episodes were quite different in terms of duration and provider visits. The chiropractic care episodes averaged 125 days in duration, or roughly 4 months, compared to medical-care only episodes that averaged about 15 days. The chiropractic care episodes averaged nine provider visits, of which eight were to DCs. Medical-only care episodes averaged 2.4 provider visits, with one visit to a primary care provider and the remainder distributed across physicians specializing in imaging, orthopedics, interventional pain management, and other services.

A simple Chi-Square test of proportions between care groups and health outcomes showed significant differences between type of care episode and decline in function and well-being. Over 30% of individuals with medical-only care episodes declined in ADLs vs. only 19% of persons with chiropractic care episodes (p-value 0.003). For IADLs, 29% of individuals with medical-only episodes declined vs. about 18% of those with chiropractic care episodes (p-value 0.002). LBF decline also differed by treatment group, with almost 38% of individuals with medical-only episodes having declined vs. 30% of individuals with chiropractic care episodes (p-value 0.05). There were no significant differences between care groups and declines in self-rated health (38.4% medical-only vs. 36.5% chiropractic) or worsening depressive symptoms (33.4% medical-only vs. 33.8% chiropractic).

## Model Results

The effect of chiropractic relative to medical-only care episodes on declines in function and well-being for the models assuming no selection bias vs. the propensity score adjusted

models are shown in Table 3. Among the models assuming no selection bias, the adjusted odds ratio for chiropractic (vs. medical only) care episodes and declines in function and well-being revealed no statistically significant differences between care types. In the propensity score weighted models, chiropractic care had a statistically significant protective effect against ADL declines (AOR 0.49, p-value 0.003), IADL declines (AOR 0.62, p-value 0.04), and declines in Self-Rated Health (AOR 0.59, p-value 0.008).

Both sets of models fit the data well, with C-statistics ranging from a low of 0.703 (decline in depressive symptoms model) to 0.799 (decline in IADLs). The Hosmer-Lemeshow statistics, however, were significant for the propensity score weighted model predicting decline in ADLs and for the decline in depressive symptoms model unadjusted for selection bias, suggesting heteroscedastic error (45). The propensity score models achieved balance in covariate means at the first of the contiguous interviews compared to the original baseline means (Appendix II). Full regression results for the ten models are available from the first author upon request.

## Discussion

This study was built upon a previously developed algorithm to define episodes of chiropractic care for back problems (17). Applying this algorithm to a nationally representative sample of older Medicare beneficiaries resulted in 1,057 individuals having clinically similar presentations of back problems occurring in-between two interviews that were all two years apart. The pattern of chiropractic care episodes closely aligned with reports from other studies demonstrating chiropractic efficacy, and was also consistent with research that showed little overlap between care provided by DCs and care provided by medical providers during back episodes (1, 2, 17, 32, 46–48). Within an average chiropractic care episode, only one of nine visits was to a non-chiropractic provider, reflecting the fact that individuals clearly had strong preferences for either chiropractic care or medical care, but not an admixture of the two.

Without adjusting for potential selection bias into chiropractic vs. medical care episodes, our findings revealed no statistically significant differences between chiropractic treatment and medical only care in single, non-recurring episodes of back conditions over a two-year period. After reweighting the data for individual propensities to use chiropractic vs. medical care, however, we observed a protective effect of chiropractic against declines in ADLs, IADLs, and declines in Self-Rated Health. The propensity score weighted model results are particularly interesting because they statistically balanced the groups using propensity scores to remove the pre-existing functional and self-rated health advantages among individuals choosing chiropractic care, and the effect of chiropractic care on function and health became significantly protective. These results suggest that when chiropractic care is delivered in practice at care levels comparable to those used in clinical trials, and relative to the types of services delivered within an episode of medical-only care, chiropractic confers significant and substantial benefits to older adult functional ability and self-rated health.

We found no differential effects on declines in lower body function or depressive symptoms between chiropractic and medical services only episodes. This indicates that while



chiropractic care was not significantly more beneficial for these health outcomes, chiropractic care did provide comparable benefits compared to medical-only care on these two health outcomes.

## Limitations

There are several limitations to this study, the first of which concerns the clinical homogeneity of the sample. We assumed that our sample selection criteria that identified only those individuals presenting to clinicians with any of the twenty-nine back conditions for a single episode of care in-between the contiguous survey interviews resulted in homogeneity in terms of the nonspecificity, complexity, and chronicity of their conditions. Medicare claims, however, are simply not sufficiently granular to empirically demonstrate this assumption.

A second limitation pertains to how the episodes of care were defined. The algorithm used here operated under a sixty-day gap between sequential claims to determine the end of an episode and the start of a new one. In previous sensitivity analyses using different gap lengths we examined the effect on episode duration and provider distribution, and found shorter gaps left many imaging claims unlinked to other services. Although future studies might find that different claims-bundling strategies for defining episodes of care result in different mean episode characteristics, our results are consistent with other research, particularly among the AHEAD sample.

A third limitation with our analysis is combining episodes of care containing medical and chiropractic services with chiropractic-only episodes of care. These types of episodes may be very different from one another in their effect on health. Moreover, the episode descriptives for chiropractic-integrated care illustrate a greater number of chiropractic services and longer episode duration than those in the pure chiropractic services-only episodes, indicating the possibility of more complex back conditions. Thus, heterogeneity resulting from combining these episode types may result in underestimating the magnitude of the beneficial effect of chiropractic.

A fourth limitation to this study is the temporal relationship between the effect of treatment for back care and the ascertainment of health outcomes. We did not account for the timing of the back treatment within the two-year window between survey interviews. This creates the possibility that other factors besides back problems may influence responses to the survey questions measuring ADLs, IADLs, LBFs, Self-Rated Health, and Depressive Symptoms.

An additional limitation is that while we have addressed selection bias by using propensity score methods, this approach may not have adjusted for unobserved confounders that could affect the care episode type and health outcome relationship (e.g., a preference for health that drives other unobserved behaviors affecting functional ability). As a result, selection bias may still be affecting the protective effects of chiropractic care that we observed.

## Conclusion

This study provides evidence of the comparative effectiveness of chiropractic care relative to medical-only services on the functional health of older adults during acute episodes of back care. Our results are the first to show the importance of examining chiropractic use within an episode of care in traditional practice settings, rather than focusing on visit frequency alone. Moreover, we evaluated the effects of the treatments received during the episodes on ADLs, IADLs, and LBFs, which are critically important measures that inform patients, clinicians, and payers about the benefits and harms of certain treatments relative to others. Given the literature supporting a minimally effective chiropractic treatment level for back problems, this research provides additional support that such therapeutic levels are indeed beneficial in terms of protecting older persons from functional declines and self-rated health over as much as two years.

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## Appendix

### Appendix I

International Classification of Diseases, 9th edition, Clinical Modification (ICD-9-CM) diagnosis codes used to identify back conditions for which chiropractic or medical care may be received

Category	Description
Dorsopathies—spondylosis and allied disorders	721.2 Thoracic spondylosis without myelopathy
	721.3 Lumbosacral spondylosis without myelopathy
	721.4 Thoracic or lumbar spondylosis with myelopathy
	721.5 Kissing spine; Bastrup's syndrome
	721.6 Ankylosing vertebral hyperostosis
	721.7 Traumatic spondylopathy; Kümmell's disease or spondylitis
	721.8 Other allied disorders of spine
	721.9 Spondylosis of unspecified site
	Dorsopathies – intervertebral disc disorders
722.2 Displacement of intervertebral disc, site unspecified, without myelopathy	
722.5 Degeneration of thoracic or lumbar intervertebral disc	

Category	Description
722.6	Degeneration of intervertebral disc, site unspecified
722.7	Intervertebral disc disorder with myelopathy
722.8	Postlaminectomy syndrome
722.9	Other and unspecified disc disorder; Calcification of intervertebral cartilage or disc Discitis
Dorsopathies – other and unspecified disorders of back	
724	Other and unspecified disorders of back
Osteopathies, chondropathies, and acquired musculoskeletal deformities	
738.4	Acquired spondylolisthesis
738.5	Other acquired deformity of back or spine
Osteopathies, chondropathies, and acquired musculoskeletal deformities, nonspecific –nonallopathic lesions not elsewhere classified	
739.2	Thoracic region
739.3	Lumbar region
739.4	Sacral region
Dislocation – other, multiple, and ill-defined dislocations	
839.2	Thoracic and lumbar vertebra, closed
839.3	Thoracic and lumbar vertebra, open
839.4	Other vertebra, closed
Sprains and strains of joints and adjacent muscles – sacroiliac region	
846	Sprains and strains of sacroiliac region
Sprains and strains of joints and adjacent muscles – other and unspecified parts of back	
847.1	Thoracic
847.2	Lumbar
847.3	Sacrum
847.4	Coccyx

## Appendix II

Comparison of group means before and after propensity score adjustment

	Unadjusted Means			Propensity Score Adjusted Means		
	Persons with Chiropractic Episodes (N=174)	Persons with Medical Care Only Episodes (N=883)	p-value <sup>a</sup>	Persons with Chiropractic Episodes (N=174)	Persons with Medical Only Episodes (N=883)	p-value <sup>a</sup>
Age	81.0	81.8	0.06	82.0	81.7	0.55
Male	0.45**	0.30	0.001	0.30	0.33	0.56
Race						

	Unadjusted Means			Propensity Score Adjusted Means		
	Persons with Chiropractic Episodes (N=174)	Persons with Medical Care Only Episodes (N=883)	p-value <sup>a</sup>	Persons with Chiropractic Episodes (N=174)	Persons with Medical Only Episodes (N=883)	p-value <sup>a</sup>
White	0.96**	0.87	0.0004	0.87	0.89	0.58
African-American	0.01**	0.08	0.002	0.08	0.07	0.52
Hispanic	0.02	0.04	0.16	0.05	0.04	0.64
Married	0.55**	0.43	0.002	0.44	0.45	0.79
Education						
Grade School	0.17	0.22	0.13	0.18	0.21	0.39
Some High School	0.12	0.16	0.12	0.13	0.16	0.19
High School	0.39*	0.32	0.05	0.39	0.32	0.09
Some College	0.32	0.30	0.58	0.30	0.30	0.97
Income Quintile						
First (lowest)	0.05**	0.12	0.003	0.09	0.11	0.53
Second	0.18*	0.26	0.02	0.28	0.25	0.36
Third	0.13	0.12	0.52	0.16	0.12	0.23
Fourth	0.22	0.19	0.28	0.16	0.19	0.32
Fifth (highest)	0.41**	0.31	0.008	0.31	0.33	0.55
More than one insurance policy	0.04	0.04	0.84	0.03	0.04	0.55
Working	0.07	0.06	0.43	0.05	0.06	0.61
Health Status in 1995						
Three or more comorbid conditions	0.34	0.39	0.19	0.36	0.38	0.53
Angina	0.06	0.11	0.07	0.09	0.10	0.73
Arthritis	0.58*	0.67	0.02	0.62	0.66	0.36
Cancer	0.18	0.17	0.77	0.15	0.17	0.50
Diabetes	0.12	0.12	0.90	0.11	0.12	0.53
Heart Attack	0.03	0.04	0.53	0.03	0.04	0.72
Hip Fracture	0.02	0.03	0.69	0.02	0.02	0.75
Hypertension	0.53	0.55	0.55	0.53	0.55	0.69
Lung Disease	0.12	0.09	0.19	0.10	0.10	0.95
Psychological problems	0.08	0.12	0.06	0.13	0.12	0.73
Stroke	0.13	0.14	0.81	0.12	0.14	0.48
Prior fall	0.32	0.40	0.07	0.38	0.39	0.89
ADL limitations	0.27***	0.64	<.0001	0.48	0.57	0.22
IADL limitations	0.28***	0.60	<.0001	0.50	0.54	0.67
Lower Body Function limitations	0.99***	1.48	<.0001	1.46	1.40	0.60
Self-Rated Health good or better	0.71**	0.59	0.002	0.60	0.62	0.61
Depressive symptoms <sup>b</sup>	1.42*	1.76	0.03	1.92	1.70	0.18
Good Vision	0.46	0.44	0.74	0.41	0.45	0.37

	Unadjusted Means			Propensity Score Adjusted Means		
	Persons with Chiropractic Episodes (N=174)	Persons with Medical Care Only Episodes (N=883)	p-value <sup>a</sup>	Persons with Chiropractic Episodes (N=174)	Persons with Medical Only Episodes (N=883)	p-value <sup>a</sup>
Good Hearing	0.45	0.46	0.69	0.44	0.46	0.66
Pain	0.25**	0.38	0.0004	0.39	0.36	0.36
Lifestyle Factors in 1995						
Vigorous Activity	0.40***	0.27	0.0001	0.31	0.29	0.66
Overweight/Obese	0.59**	0.47	0.003	0.51	0.49	0.65
Former Smoker	0.50	0.44	0.12	0.41	0.45	0.34
Current Smoker	0.04	0.05	0.49	0.06	0.05	0.50
Drink more than 1 alcoholic drink per day	0.32**	0.20	0.0003	0.21	0.22	0.75
Health Services Use						
Prior hospitalization	0.30*	0.38	0.04	0.34	0.37	0.53
Prior Back Condition episode	0.18	0.13	0.11	0.13	0.14	0.67
Respondent Status						
Self-respondent at survey 1 and survey 2	0.88*	0.82	0.04	0.87	0.83	0.14
Self-respondent at survey 1, proxy at survey 2	0.06	0.08	0.22	0.06	0.08	0.36
Proxy at survey 1, self-respondent at survey 2	0.03	0.02	0.22	0.04*	0.02	0.03
Proxy at survey 1, proxy at survey 2	0.03*	0.08	0.02	0.03*	0.08	0.02

<sup>a</sup>Chi-square test of proportions used for categorical variables, t-tests used for continuous.

<sup>b</sup>Depressive symptoms count was asked only of self-respondents (N=951)

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### Practical Applications

Three to 5 short sentences that highlight *findings* of the study. These statements should relate directly to the study findings.

- Chiropractic episodes were longer in duration and contained more visits to providers than those that were medical only episodes
- Chiropractic care episodes are protective against two-year declines in Activities of Daily Living among older adults
- Chiropractic care episodes are protective against two-year declines in lower body function among older adults
- No comparative benefit or harm of chiropractic episodes on declines in instrumental activities of daily living, self-rated health, and depressive symptoms among older adults

**Table 1**

Means of entire sample and by episode group

	Entire Analytic Sample (N=1,057)	Persons with Chiropractic Episodes <sup>a</sup> (N=174)	Persons with Medical Care Only Episodes (N=883)
Age	81.7	81.0	81.8
Male	0.33	0.45**	0.30
Race			
White	0.89	0.96**	0.87
African-American	0.07	0.01**	0.08
Hispanic	0.04	0.02	0.04
Married	0.45	0.55**	0.43
Education			
Grade School	0.21	0.17	0.22
Some High School	0.16	0.12	0.16
High School	0.33	0.39*	0.32
Some College	0.30	0.32	0.30
Income Quintile			
First (lowest)	0.11	0.05**	0.12
Second	0.25	0.18*	0.26
Third	0.12	0.13	0.12
Fourth	0.19	0.22	0.19
Fifth (highest)	0.33	0.41**	0.31
More than one insurance policy	0.04	0.04	0.04
Working	0.06	0.07	0.06
Health Status in 1995			
Three or more comorbid conditions	0.38	0.34	0.39
Angina	0.10	0.06	0.11
Arthritis	0.65	0.58*	0.67
Cancer	0.17	0.18	0.17
Diabetes	0.12	0.12	0.12
Heart Attack	0.04	0.03	0.04
Hip Fracture	0.02	0.02	0.03
Hypertension	0.55	0.53	0.55
Lung Disease	0.10	0.12	0.09
Psychological problems	0.12	0.08	0.12
Stroke	0.14	0.13	0.14
Prior fall	0.38	0.32	0.40
ADL limitations	0.58	0.27***	0.64
IADL limitations	0.54	0.28***	0.60
Lower Body Function limitations	1.39	0.99***	1.48

	Entire Analytic Sample (N=1,057)	Persons with Chiropractic Episodes <sup>a</sup> (N=174)	Persons with Medical Care Only Episodes (N=883)
Self-Rated Health good or better	0.62	0.71**	0.59
Depressive symptoms <sup>b</sup>	1.70	1.42*	1.76
Good Vision	0.45	0.46	0.44
Good Hearing	0.46	0.45	0.46
Pain	0.36	0.25**	0.38
Lifestyle Factors in 1995			
Vigorous Activity	0.29	0.40***	0.27
Overweight/Obese	0.49	0.59**	0.47
Former Smoker	0.45	0.50	0.44
Current Smoker	0.05	0.04	0.05
Drink more than 1 alcoholic drink per day	0.22	0.32**	0.20
Health Services Use			
Prior hospitalization	0.37	0.30*	0.38
Prior Back Condition episode	0.14	0.18	0.13
Respondent Status			
Self-respondent at survey 1 and survey 2	0.83	0.88*	0.82
Self-respondent at survey 1, proxy at survey 2	0.08	0.06	0.08
Proxy at survey 1, self-respondent at survey 2	0.02	0.03	0.02
Proxy at survey 1, proxy at survey 2	0.07	0.03*	0.08

<sup>a</sup> Chi-square test of proportions used for categorical variables, t-tests used for continuous.

<sup>b</sup> Depressive symptoms count was asked only of self-respondents (N=951)

\* Indicates statistical significance at < 0.05;

\*\* < 0.01;

\*\*\* < 0.0001.

**Table 2**

Episode description by group

	N	Mean Days in Episode	Mean Provider Visits in Episode	Provider Type				
				Mean Number of Visits to DC	Mean Number of Visits to Primary Care	Mean Number of Visits to Imaging	Mean Number of Visits to Orthopedist	Mean Number of Visits to Interventional Pain Physicians
Chiropractic episodes <sup>1</sup>	174	125.4	8.8	7.8	0.5	0.2	0.1	0.2
Chiropractic only	130	106.3	7.0	7.0	0	0	0	0
Chiropractic + Medical	44	185.8	14.6	10.3	2.2	0.8	0.3	0.8
Medical-only episodes	883	14.9	2.4	0	1	0.4	0.3	0.2

<sup>1</sup>Chiropractic episodes include episodes with chiropractic services only (73%) and episodes that have chiropractic and medical services (24%).



**Table 3**

Adjusted Odds Ratios (AORs) of chiropractic care episodes relative to medical-only episodes on declines in health

	<b>Decline in Activities of Daily Living</b>	<b>Decline in Instrumental Activities of Daily Living</b>	<b>Decline in Lower Body Function</b>	<b>Decline in Self- Rated Health</b>	<b>Decline in Depressive Symptoms</b>
<b>Ignoring Selection Bias Model:</b>					
Chiropractic care episodes	0.66	0.69	0.72	0.71	0.95
95% Confidence Interval	(0.416, 1.058)	(0.427, 1.121)	(0.489, 1.055)	(0.493, 1.035)	(0.650, 1.380)
<i>p-value</i>	0.08	0.13	0.09	0.08	0.77
<b>Propensity Score Model:</b>					
Chiropractic care episodes	<b>0.49</b>	<b>0.62</b>	0.74	<b>0.59</b>	1.06
95% Confidence Interval	<b>(0.307, 0.788)</b>	<b>(0.383, 0.988)</b>	(0.505, 1.097)	<b>(0.397, 0.868)</b>	(0.723, 1.54)
<i>p-value</i>	<b>0.003</b>	<b>0.04</b>	0.14	<b>0.008</b>	0.78

Note: **Bold** indicates statistical significance < 0.05