

CHIROPRACTIC USE IN THE MEDICARE POPULATION: PREVALENCE, PATTERNS, AND ASSOCIATIONS WITH 1-YEAR CHANGES IN HEALTH AND SATISFACTION WITH CARE

Paula A.M. Weigel, PhD,^a Jason M. Hockenberry, PhD,^b and Fredric D. Wolinsky, PhD^c

ABSTRACT

Objective: The purpose of this study was to examine how chiropractic care compares to medical treatments on 1-year changes in self-reported function, health, and satisfaction with care measures in a representative sample of Medicare beneficiaries.

Methods: Logistic regression using generalized estimating equations is used to model the effect of chiropractic relative to medical care on decline in 5 functional measures and 2 measures of self-rated health among 12 170 person-year observations. The same method is used to estimate the comparative effect of chiropractic on 6 satisfaction with care measures. Two analytic approaches are used, the first assuming no selection bias and the second using propensity score analyses to adjust for selection effects in the outcome models.

Results: The unadjusted models show that chiropractic is significantly protective against 1-year decline in activities of daily living, lifting, stooping, walking, self-rated health, and worsening health after 1 year. Persons using chiropractic are more satisfied with their follow-up care and with the information provided to them. In addition to the protective effects of chiropractic in the unadjusted model, the propensity score results indicate a significant protective effect of chiropractic against decline in reaching.

Conclusion: This study provides evidence of a protective effect of chiropractic care against 1-year declines in functional and self-rated health among Medicare beneficiaries with spine conditions, and indications that chiropractic users have higher satisfaction with follow-up care and information provided about what is wrong with them. (*J Manipulative Physiol Ther* 2014;37:542-551)

Key Indexing Terms: *Chiropractic; Medicare; Activities of Daily Living; Patient Satisfaction*

National surveys and other data show chiropractic use prevalence rates among those 18 years and older, ranging between 5.6% and 8.6% in the United States.¹⁻³ Among Medicare beneficiaries 70 years and older, chiropractic use is less prevalent, with 2 studies indicating

annual rates ranging between 4.1% and 5.4%.^{4,5} For younger Medicare beneficiaries, chiropractic prevalence rates are closer to national rates, ranging between 6% and 7%.⁶ Although informative, these estimates are not reflective of the population that commonly seeks care from doctors of chiropractic—namely, persons seeking treatment of spine-related health conditions.^{2,7-9} Prevalence of chiropractic use is likely higher in the population of Medicare beneficiaries with back and neck conditions, but how much higher is not known.

Spine-related problems are common in the general adult population, and there is evidence of increasing prevalence as people age.¹⁰⁻¹⁴ As a result, spine conditions reflect a growing portion of health services use and expenditures, particularly under Medicare.^{6,15,16} More significantly, these problems are associated with increased disability by impeding a person's capacity to perform everyday mobility tasks such as walking, stooping, lifting, or reaching. Those mobility tasks can subsequently limit a person's ability to perform basic activities of daily living (ADLs), all of which are crucial to prolonging independence among older adults living in a community setting.¹⁷⁻²²

^a Research Associate, Department of Health Management and Policy, College of Public Health, The University of Iowa, Iowa City, IA.

^b Assistant Professor, Health Policy and Management, Rollins School of Public Health, Emory University, Atlanta, GA.

^c Professor, John W. Colloton Chair of Health Management and Policy, Department of Health Management and Policy, College of Public Health, The University of Iowa, Iowa City, IA.

Submit requests for reprints to: Paula A.M. Weigel, MS, PhD, Research Associate, College of Public Health, The University of Iowa, S161 CPHB, 145 N. Riverside Drive, Iowa City, IA 52242. (e-mail: Paula-Weigel@uiowa.edu).

Paper submitted April 16, 2014; in revised form May 30, 2014; accepted June 10, 2014.

0161-4754

Copyright © 2014 by National University of Health Sciences.

Open access under [CC BY-NC-ND license](https://creativecommons.org/licenses/by-nc-nd/4.0/).

<http://dx.doi.org/10.1016/j.jmpt.2014.08.003>

Medicare covers several treatment options ranging from the noninvasive like chiropractic and physical therapy to the more invasive, such as steroidal injections and surgery. Studies have shown that the technologically intensive treatment types have grown more dramatically, both in use and in expenditures, than the noninvasive kind over the past 15 to 20 years.^{3,6,12,16,23–26} Although these studies document the increasing use of interventional treatments, they also note that population-level improvements in outcomes and disability have not improved commensurately.

Recent research, however, suggests that chiropractic use benefits older Medicare beneficiaries (>70 years) by protecting them against decline in function and self-rated health (SRH).²⁷ Because that study used Medicare claims to compare outcomes between users of chiropractic and users of medical care treatments in uncomplicated back conditions over a 2-year period, it represents a real-world approximation of the relative benefit of chiropractic use on health outcomes.

Given the escalating costs of treatment and the ramifications of disability on future dependency,^{28,29} it is important to understand the prevalence and the relative effect on health and care, costs of chiropractic use among age-eligible Medicare beneficiaries with spine-related problems. Equally important is how patients view the quality of care received from different treatment types. If treatments have comparable effects on health, but disparate care costs or satisfaction, then policy makers may consider incentives or disincentives to promote particular treatments for certain conditions.

This study uses the Medicare Current Beneficiary Survey (MCBS) linked to Medicare provider claims to examine chiropractic use among Medicare beneficiaries with spine conditions. This research study has 3 objectives: (1) to describe the prevalence of chiropractic use among age-eligible Medicare beneficiaries in general and among those with spine problems in particular; (2) to describe treatment patterns, service trends, and Medicare expenditures among persons who mostly use chiropractic vs those that are users of medical care only; and (3) to determine the comparative effect of chiropractic relative to medical care only on 1-year changes in function, SRH, and satisfaction with care.

METHODS

Study Population

A detailed description of the MCBS, associated technical documentation, and its sample design can be found elsewhere.^{30,31} We used the MCBS survey linked to provider claims between 1997 and 2006 to construct 9 person-year observations for Medicare beneficiaries, which were then pooled to examine changes in health outcomes. The MCBS is a continuous, rotating panel survey of a nationally representative sample of Medicare beneficiaries

sponsored by the Centers for Medicare and Medicaid Services. The Access to Care file contains survey participants' demographic and socioeconomic information, their health and functional status, health care use history, and satisfaction with care responses. The matched claims data include Medicare payment for physician services.³²

Sample

Our sample includes fee-for-service Medicare beneficiaries who were age eligible (>65 years) and living in the community at the time of their first and second interviews. We excluded persons with end-stage renal disease because their functional health trajectory differs from those who do not have permanent kidney failure, and we excluded those who did not survive to the end of the second interview year because of their imminent mortality. Survey participants had to have 2 consecutive interviews 1 year apart to determine changes in health outcomes. Self- or proxy respondents were included in each person-year panel.

To be included in the spine condition subsample, MCBS participants had to have at least 1 claim with an *International Classification of Diseases, Clinical Modification (ICD-9-CM)* diagnosis code falling under the category of "Diseases of the Musculoskeletal System and Connective Tissue" or "Dislocation" or "Sprains and Strains of Joints and Adjacent Muscles" between first and second interviews (see [Appendix 1](#) for the *ICD-9-CM* diagnosis codes used). Diagnoses by medical doctors that contraindicated chiropractic (eg, 839.1 "Cervical Vertebra, open" or 839.3 "Thoracic and Lumbar Vertebra, open") were excluded.

Outcome Measures

We examined 13 outcomes, 5 measuring functional decline, 2 measuring changes in self-assessed health, and 6 reflecting satisfaction with discrete aspects of care. Of the 5 functional health outcomes, the first is decline in ADLs. The ADL measure was the sum of 5 daily activities that the participant reported difficulties in or the inability to perform at the time of their interview: bathing, getting in or out of a chair, dressing, eating, and walking across a room. A decline is reflected by a person adding at least 1 new ADL limitation between interviews. The remaining functional decline measures reflect going from one level of difficulty to a greater difficulty level (eg, from "little difficulty" to "some difficulty") on 4 tasks: lifting or carrying ten pounds (lifting), extending arms above shoulder (reaching), stooping/crouching/kneeling (stooping), and walking ¼ mile or 2 to 3 blocks (walking).

The 2 self-reported health outcomes are decline in SRH and changes in comparative health after 1 year. Decline in SRH occurred if a person rated their general health at a worse level in the second interview compared with the first. The 5 response options were excellent (1), very good

(2), good (3), fair (4), and poor (5). The comparative health measure was in response to the question “Health compared to 1 year ago is _____,” where response options were “much better,” “somewhat better,” “about same,” “somewhat worse,” or “much worse.” Responses were collapsed into “worse comparative health” relative to “same comparative health” and “better comparative health.”

The 6 satisfaction outcome measures address quality of care received over the past year, doctor’s concern for overall health, out-of-pocket costs for services, ease of getting to doctor, satisfaction with follow-up care, and satisfaction with information about what was wrong. Responses were dichotomized to “satisfied” (1) or “dissatisfied” (0).

Focal Variable

The focal variable is chiropractic use. If a participant used any chiropractic services during the year between survey interviews indicated by a provider specialty code of “35” in the Medicare Part B claims, he/she was designated a chiropractic user and coded 1 on the treatment variable. If not, the person was assigned to medical care only status and coded 0. Although a participant in the chiropractic treatment group could also use other nonchiropractic services for spine treatment, prior research has indicated that conditional upon choosing chiropractic for a particular care episode, most services used during that episode are chiropractic.^{27,33}

Covariates

Using Andersen and Aday’s behavioral model of health services use,^{34,35} we included a set of covariates in all analyses to account for potential risk factors.^{4,5} Predisposing factors include age, sex, and race. Enabling factors are marital status, education, income, and metro/nonmetro location of residence. Need factors include disease history markers (arthritis, broken hip, cancer, coronary heart disease, chronic obstructive pulmonary disease, diabetes, heart attack, hypertension, osteoporosis, psychological problems, rheumatoid arthritis, and stroke), as well as functional status at time of first interview (ADLs, difficulty lifting, reaching, stooping, and walking), SRH, vision and hearing acuity, and health worries.

Other need factors influenced by lifestyle and prior health services use include 4 weight categories based on body mass index cutoffs (underweight, normal, overweight, and obese), 2 smoking status measures (“ever smoke” and “currently smoke”), and 2 measures of health services use in the prior year (hospitalized or not, and a 3-level categorization of office visits—none, 1-5, and ≥ 6).

Finally, we included a marker of whether a person participated in managed care or not during the year and indicators of whether a person was a self-respondent at both interviews, a proxy at both interviews, or a

combination of self- and proxy at either interview. These variables were included because (1) the claims experience of persons in managed care would be different than those in fee-for-service (under-represented), and (2) the assessments of change in function and health are affected by whom (self-respondent vs proxy respondent) is answering the survey questions.¹⁸

Analysis

The prevalence of chiropractic use among all Medicare beneficiaries and among those with spine conditions is described. Treatment patterns are characterized by the average number of services provided and the portion that are chiropractic, as well as by the mix of providers seen each year. Average Medicare Part B expenditures on behalf of beneficiaries with spine conditions are calculated for each treatment group each year, as is the subset of spending on chiropractic services. Spending for spine conditions from institutional-based services (such as inpatient stays) or Part D benefits, however, is not characterized here. Trends are described for mean service volume, provider distribution, and mean expenditures. The comparative effect of care for persons incorporating chiropractic into their treatment plan relative to care among persons using only medical or nonchiropractic services (eg, physical therapy) on 1-year changes in health and satisfaction is modeled. Because each person may contribute several person-period observations, we used generalized estimating equations logistic regression methods to adjust for within-person correlation. To account for potential selection bias inherent in comparing different treatment effects in observational data,^{36–39} propensity score-weighted models are also estimated on the health and satisfaction outcomes. The propensity score models used state chiropractor supply data for the interview start year, in addition to other known risk factors to estimate a probability of chiropractic use for each person-year observation.^{4,5,40–42} Once the propensity scores were estimated, the inverse probability of treatment weights (IPTWs) were calculated and multiplied by the 1-year sample weight provided in the MCBS to obtain a propensity score-adjusted sample weight.

Human Subjects Approval. This research was supported by Grant R21 AT004578 from the National Institutes of Health to Dr Wolinsky. The human subject protocol was fully approved by the University of Iowa Institutional Review Board 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) were approved in March 2005 with subsequent modifications and extensions through 2014. Written informed consent was obtained from all AHEAD participants.

Table 1. Annual Prevalence of Chiropractic Use

	Panel 1	Panel 2	Panel 3	Panel 4	Panel 5	Panel 6	Panel 7	Panel 8	Panel 9
Sample Descriptives	97-98	98-99	99-00	00-01	01-02	02-03	03-04	04-05	05-06
Persons with 2 interviews	8832	8898	8699	8583	8540	8406	8071	8065	7969
Persons who have claims (treated)	7194	6996	6899	7037	7122	7055	6718	6696	6553
Chiropractic users	567	549	580	623	599	618	634	670	694
% of total sample	6.4%	6.2%	6.7%	7.3%	7.0%	7.4%	7.9%	8.3%	8.7%
% of treated sample	7.9%	7.8%	8.4%	8.9%	8.4%	8.8%	9.4%	10.0%	10.6%
Persons with claims between 1st and 2nd interviews	6836	6633	6607	6763	6840	6794	6469	6462	6324
Chiropractic users	462	417	474	496	459	481	501	528	563
% of treated sample with 2 interviews	6.8%	6.3%	7.2%	7.3%	6.7%	7.1%	7.7%	8.2%	8.9%
Persons with spine conditions	1256	1154	1278	1368	1360	1413	1390	1452	1499
Chiropractic users	440	401	456	479	441	463	477	505	540
% of spine sample using chiropractic	35.0%	34.7%	35.7%	35.0%	32.4%	32.8%	34.3%	34.8%	36.0%

RESULTS

Prevalence

The average annual population prevalence of community-dwelling and age-eligible Medicare beneficiaries using chiropractic was 7.4% (range, 6.3%-8.9%). Among persons with spine conditions, the average annual prevalence was 34.5% (range, 32.4%-35.7%). Year-by-year prevalence rates are shown in Table 1.

Sample Descriptives

Table 2 compares persons who used chiropractic with those that did not for treatment of spine conditions. People who chose chiropractic for their spine care were significantly younger, male, white, and married. They were high school graduates, in the highest income category (>\$25 000), and comparatively less likely to live in metropolitan areas. Chiropractic users were also relatively healthier than the medical only group based on presence of disease conditions and having significantly lower proportions of arthritis and rheumatoid arthritis; heart disease, heart attacks, and stroke; and diabetes, hypertension, and osteoporosis, although among these last 3 conditions, the prevalence among users of chiropractic increased over time.

Chiropractic users also had significantly less functional limitation as reflected by fewer ADLs and less self-reported difficulty lifting, reaching, stooping, and walking several blocks. Vision was better and SRH higher among those using chiropractic. The proportion of chiropractic users worried about their health was significantly lower than those using medical only care, which could be a reflection of the relative disease burden for each group.

Finally, chiropractic users had proportionately fewer hospitalizations in the year prior to their first interview and were less prevalent in the highest category of office visits (>6 per year) compared with medical only users. Again, this difference in health services use could be a reflection of the disparity in disease conditions. The chiropractic use group also had significantly higher represen-

tation in the category of self-respondent at both first and second interviews.

Unadjusted Differences in Outcomes

Table 3 presents unadjusted differences on the outcomes. The chiropractic user group experienced proportionately less functional decline as reflected by limitations in ADLs and difficulty in lifting, reaching, and walking several blocks. They were also less likely to rate their health worse over the year compared with those in the medical services only group. Among the satisfaction measures, persons in the chiropractic use group were more satisfied with care quality, out-of-pocket costs, follow-up after the initial visit, and with information provided about what was wrong with them. There were no differences between treatment groups on decline in SRH, satisfaction with providers' concern, and ease of getting to doctor from where participant lives.

Patterns of Use by Treatment Group

The average annual volume of services used to treat spine conditions grew between 1997 and 2006 among both treatment groups. The chiropractic user group had nearly double the average service volume of the medical only group (mean, 15.2 services per year vs 7.7, respectively) over the 9 person-year panels. On average, 82% of the service volume among chiropractic users was chiropractic, with primary care (internal medicine, general practice, family practice) being only 5%. Over time, however, the percentage of services that were chiropractic decreased as other nonchiropractic services was used to treat spine conditions.

The mix of providers also changed over time and within treatment groups. Among chiropractic users, services sought from physical therapists grew from 0.7% in the 1997 to 1998 panel to 9.2% in the 2003 to 2004 panel. Likewise, among the medical only group, physical therapy services as a portion of all services grew markedly between the 1997 to 1998 panel and the 2004 to 2005 panel (from 12.1% to 32.2%). In the medical care only group,

Table 2. Overall Means and Means by Treatment Category

	Overall Sample	Users of Chiropractic	Medical-only Users
n (person-years)	12170	4201	7969
Age (y)			
65-69	0.24	0.28 ^c	0.22
70-74	0.28	0.29 ^a	0.27
75-79	0.23	0.23	0.24
80-84	0.16	0.14 ^c	0.17
85+	0.10	0.07 ^c	0.11
Sex			
Male	0.37	0.42 ^c	0.35
Race			
White	0.91	0.96 ^c	0.88
African American	0.05	0.02 ^c	0.07
Hispanic	0.02	0.004 ^c	0.03
Other	0.02	0.01 ^c	0.03
Marital status			
Married	0.57	0.62 ^c	0.55
Widowed	0.32	0.28 ^c	0.35
Other marital status	0.10	0.09	0.1
Education			
Grade	0.12	0.09 ^c	0.14
Some high school	0.15	0.14 ^b	0.16
High school	0.32	0.36 ^c	0.29
Post-high school	0.41	0.40	0.41
Income			
<10 000	0.17	0.12 ^c	0.19
10 000-25 000	0.40	0.39	0.40
≥25 000	0.42	0.48 ^c	0.4
Metro area	0.71	0.63 ^c	0.76
Disease status			
Arthritis	0.67	0.60 ^c	0.71
Broken hip	0.04	0.02 ^c	0.04
Cancer	0.18	0.18	0.19
CHD	0.15	0.12 ^c	0.17
COPD	0.15	0.14 ^c	0.16
Diabetes	0.18	0.15 ^c	0.19
Heart attack	0.15	0.12 ^c	0.16
Hypertension	0.60	0.55 ^c	0.62
Osteoporosis	0.22	0.17 ^c	0.25
Psychological problems	0.09	0.07 ^c	0.10
Rheumatoid arthritis	0.12	0.09 ^c	0.13
Stroke	0.11	0.08 ^c	0.12
Function and mobility limitations			
ADLs sum	0.57	0.36 ^c	0.68
Difficulty with:			
Bathing	0.10	0.06 ^c	0.12
Getting out of a chair	0.14	0.09 ^c	0.17
Dressing	0.06	0.04 ^c	0.07
Eating	0.02	0.01 ^b	0.02
Walking across a room	0.26	0.18 ^c	0.31
Lifting	1.98	1.65 ^c	2.15
Reaching	1.64	1.49 ^c	1.71
Stooping	2.80	2.55 ^c	2.93
Walking several blocks	2.32	1.93 ^c	2.53
General health	2.75	2.48 ^c	2.89
Vision trouble	0.34	0.30 ^c	0.37
Hearing trouble	0.40	0.40	0.40
Worries more	0.16	0.11 ^c	0.19
Lifestyle			
Obese	0.23	0.24	0.23

(continued)

Table 2. (continued)

	Overall Sample	Users of Chiropractic	Medical-only Users
Overweight	0.38	0.40 ^a	0.38
Normal weight	0.34	0.33 ^b	0.35
Underweight	0.04	0.04	0.05
Ever smoke	0.56	0.56	0.55
Smoke currently	0.09	0.08 ^b	0.10
Health services use			
Hospitalization	0.21	0.16 ^c	0.23
Office visits			
None	0.06	0.09 ^c	0.05
1-5	0.31	0.37 ^c	0.28
6+	0.63	0.54 ^c	0.67
Managed care participation	0.03	0.02 ^a	0.03
Respondent status			
Self T1 and Self T2	0.89	0.92 ^c	0.88
Self T1 and Proxy T2	0.04	0.02 ^c	0.04
Proxy T1 and Self T2	0.02	0.03	0.02
Proxy T1 and Proxy T2	0.05	0.03 ^c	0.05

ADL, activities of daily living; CHD, coronary heart disease; COPD, chronic obstructive pulmonary disease.

^a Significant at <.05 level.

^b Significant at <.01 level.

^c Significant at <.001 level.

there was greater provider heterogeneity, ranging from primary care providers delivering 21% of services to physical therapists/physical medicine and rehabilitation (28%) to specialists such as orthopedists and anesthesiologists (18.3%). Neurology and neurosurgery services also grew over the period in the medical only group. The heterogeneity may be due to patient preferences, clinical indication, condition severity or chronicity, or a combination of these factors, all of which are unobservable from claims data. Detailed data on provider distributions by treatment group are available from the first author upon request.

Average annual Medicare spending on spine-related conditions roughly doubled over the 9-year period. Spending trends for both treatment groups were similar between 1997 and 2002, but diverged after 2002 when spending in the chiropractic user group grew at a slower rate than that of the medical group (Fig. 1). Medicare spending on chiropractic remained flat between 1999 and 2006, decreasing from 71% of total spending on spine conditions in 1999 to 2000 to 48% of total spending in 2005 to 2006.

Effect of Chiropractic on Outcomes

Table 4 shows the results for both the unadjusted and adjusted health outcome models. Without adjusting for selection bias, we found that chiropractic was significantly protective against declines in ADLs, lifting, stooping, and walking several blocks. After adjusting for potential selection bias using IPTWs, we observed a protective effect of chiropractic against decline in all 5 functional outcomes, including reaching. Chiropractic was also found to be protective against 1-year declines in SRH and worsening

Table 3. Unadjusted Differences in Outcomes

Outcome Means	Overall Sample	Users of Chiropractic	Medical-only Users
Function and mobility			
Declines in:			
ADLs	0.19	0.14 ^c	0.21
Lifting	0.26	0.21 ^c	0.29
Reaching	0.21	0.17 ^c	0.22
Stooping	0.32	0.31 ^c	0.33
Walking several blocks	0.26	0.23 ^c	0.27
Global health measures			
Decline in SRH			
Health compared with last year	0.30	0.29	0.30
Better	0.16	0.17 ^b	0.15
Same	0.55	0.61 ^c	0.51
Worse	0.30	0.22 ^c	0.34
Satisfaction measures			
Satisfied with:			
Quality	0.97	0.97 ^a	0.97
Concern	0.96	0.96	0.95
Costs	0.87	0.88 ^b	0.86
Ease	0.96	0.96	0.95
Follow-up	0.97	0.98 ^c	0.96
Information	0.95	0.96 ^b	0.94

ADL, activities of daily living; SRH, self-rated health.

Note: Mean spending amounts adjusted to 2005 dollars using 1997-2005 gross domestic product price indices.

^a Significant at <.05 level.

^b Significant at <.01 level.

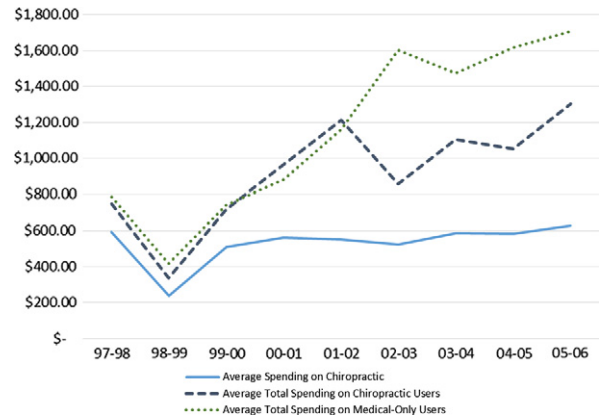
^c Significant at <.001 level.

health compared with 1 year ago in both the unadjusted and adjusted models.

Table 5 shows the results for both the unadjusted and adjusted satisfaction outcome models. Participants in the chiropractic use group had higher satisfaction with follow-up after initial visit and with information provided about what was wrong with them. These results were consistent in magnitude regardless of whether the models adjusted for selection using the IPTWs or not.

DISCUSSION

We investigated chiropractic use among community-dwelling age-eligible Medicare beneficiaries over a 9-person-year period (1997-2006). We found annual prevalence rates similar to those reported from the National Health Interview Surveys.^{1,2} Our prevalence estimates for chiropractic use among beneficiaries with spine diagnoses, however, are much higher (35%), indicating that chiropractic is a commonly sought treatment among those with back and neck problems. Furthermore, chiropractic users appear to have strong preferences for chiropractic treatment once they choose chiropractic compared with other types of services based on the percent of overall service volume for chiropractic relative to other care, although the data on provider mix suggest a trend toward service provision by others.



Note: Mean spending amounts adjusted to 2005 dollars using 1997-2005 GDP price indices.

Fig 1. Average annual Medicare Part B spending on spine treatments, 1997 to 2006.

Service volume trends were similar between treatment groups, with average yearly service volume steadily increasing between the 1997 to 1998 panel and the 2005 to 2006 panels. On a percentage basis, however, service volume in the medical only group grew slightly more between the 1997 to 1998 panel and the 2005 to 2006 panel (58% vs 41% for the chiropractic use group). Chiropractic volume grew at a lesser rate than the overall average volume, and consequently, chiropractic volume as a percentage of all services used to treat spine conditions declined over time (from 90% in 1997-1998 to 78% in 2005-2006). This trend is also evident in the distribution of provider data, where a growing proportion of services among the chiropractic use group went to physical therapists.

As a byproduct of the service volume growth and differences in prices between general and specialty care, average spending per year by Medicare also increased between the first and last panels in both groups. Once again, this occurred at a faster rate in the medical only group relative to the chiropractic user group (117% vs 74%, respectively). Furthermore, the percent growth in average chiropractic spending per year from 1997-1998 to 2005-2006 was only 6%, which is remarkably lower than the growth in overall spending in each group. Inflation-adjusted spending on chiropractic was essentially flat over the period and was accompanied by a declining portion of total spending among persons using chiropractic (from 79% to 48% in 1997-1998 and 2005-2006, respectively). In support of conclusions by Whedon et al.⁶ about trends in use and costs of chiropractic spinal manipulation in the Medicare population, our results suggest Medicare payments for chiropractic services (at least among those with spine conditions) are relatively less of a payment vulnerability for the Medicare program than has been implied in the past.^{4,3}

We found that chiropractic use is comparatively protective against 1-year declines in function and self-assessed health among Medicare beneficiaries with spine conditions and is

Table 4. Adjusted Odds Ratios (AORs) of Chiropractic Effect on Decline in Function and Health

AORs	ADL	Lifting	Reaching	Stooping	Walking	SRH	Worse Comparative Health
Not adjusted for potential selection bias	0.78	0.75	0.90	0.82	0.80	0.81	0.74
<i>P</i>	<.0001	<.0001	0.05	0.0001	<.0001	<.0001	<.0001
Adjusted for potential selection bias	0.77	0.76	0.88	0.82	0.81	0.80	0.75
<i>P</i>	<.0001	<.0001	0.03	0.0002	<.0001	<.0001	<.0001

ADL, activities of daily living.

Note: Modeling “Decline” relative to “No Decline” on functional and SRH outcomes, and “Worse Comparative Health” relative to “Same” or “Better.”

Table 5. Adjusted Odds Ratios (AORs) of Chiropractic Effect on Satisfaction Measures

AORs	Quality	Concern	Costs	Ease	Follow-Up	Information
Not adjusted for potential selection bias	1.14	1.10	1.07	0.89	1.59	1.25
<i>P</i>	.34	.40	.32	.33	.003	.03
Adjusted for potential selection bias	1.10	1.11	1.07	0.95	1.57	1.28
<i>P</i>	.47	.37	.35	.65	.004	.02

Note: Modeling “Satisfied” relative to “Not Satisfied.”

also associated with higher satisfaction on measures of follow-up care and with information provided. Furthermore, we found that the models measuring the effect of chiropractic on functional health, SRH, and satisfaction with care using IPTWs are consistent with the models that are not adjusted for potential selection to treatment. By using propensity score methods, we accounted for potential selection bias using the data available. In so doing, we demonstrated that the causal effects using IPTWs were similar to those observed without such adjustments.

Limitations and Future Research. The decision to combine back and neck conditions in these analyses introduces clinical condition heterogeneity that could make indistinguishable the comparative effect of chiropractic on health changes for certain specific conditions. However, we felt that expanding the number and types of conditions for which people consistently choose chiropractic was important to the overall picture of how chiropractic is used in this population.

We did not aggregate service use into episodes of care but rather looked at overall service use and spending over the course of a year. Whether chiropractic treatment is comparatively effective at slowing functional decline is a function of how it is delivered in practice for a particular clinical presentation. Evidence of chiropractic efficacy has shown a minimally effective “dosing” level of up to 12 treatments over a several week period, with some studies suggesting that an additional monthly treatment thereafter prolongs the benefit.⁴⁴⁻⁴⁶ Combining related service claims into episodes of care could further refine treatment effect estimates, although it would likely introduce analytical complexity due to care that is proximal but outside the 1-year interview window (left and right censoring).

Another limitation is related to the satisfaction with care outcomes. Questions regarding satisfaction in the

MCBS are not specific to a particular treatment delivered for an identifiable health condition but rather are about the medical services received since the time of the last interview. Accordingly, a distinction cannot be made between health services delivered for a back condition vs those delivered for a heart condition. Persons seeking treatment of spine conditions had health services use for other conditions as well, thus confounding satisfaction perceptions across a variety of providers. Had the questions been related only to care received for spine conditions, a better distinction between treatment groups could be made.

Despite attempts to adjust for potential selection bias using IPTWs, it remains possible that unobserved confounders affected the treatment effect on declines in health.

Future research will focus on distinguishing further among specific types of spine conditions to better determine the comparative effect of chiropractic relative to medical only care on the health and well-being of Medicare beneficiaries with specific clinical conditions.

CONCLUSION

This study found prevalence of chiropractic use among age-eligible Medicare beneficiaries consistent with that of the US adult population, but among those seeking care for spine problems, we observed a much higher prevalence rate. Service volume trends between 1997 and 2006 showed growth in the average number of services used to treat spine conditions, although the percentage growth of chiropractic services was nearly flat compared with overall service volume growth. Medicare spending on spine conditions grew as a consequence of higher service volume and more expensive services, although spending on chiropractic was relatively flat and declined as a percentage of total spending among those choosing chiropractic.

This study provides evidence of a protective effect of chiropractic against 1-year declines in functional and SRH among Medicare beneficiaries with spine conditions, and indications that chiropractic users have higher satisfaction with follow-up care and information provided about what is wrong with them.

FUNDING SOURCES AND POTENTIAL CONFLICTS OF INTEREST

This study was funded by Grant R21 AT004578 from the National Institutes of Health. No conflicts of interest were reported for this study.

CONTRIBUTORSHIP INFORMATION

Concept development (provided idea for the research): P.W., J.H., F.D.W.

Design (planned the methods to generate the results): P.W., F.D.W.

Supervision (provided oversight, responsible for organization and implementation, writing of the manuscript): J.H., F.D.W.

Data collection/processing (responsible for experiments, patient management, organization, or reporting data): P.W.

Analysis/interpretation (responsible for statistical analysis, evaluation, and presentation of the results): P.W., F.D.W.

Literature search (performed the literature search): P.W.
Writing (responsible for writing a substantive part of the manuscript): P.W.

Critical review (revised manuscript for intellectual content, this does not relate to spelling and grammar checking): F.D.W., J.H.

Practical Applications

- This study's findings show that chiropractic care has a protective effect against 1-year decline in function among Medicare beneficiaries.
- Chiropractic care has a protective effect against 1-year decline in SRH among Medicare beneficiaries.
- Medicare beneficiaries that use chiropractic care are comparatively more satisfied with their follow-up care and with the information provided to them about their condition.

REFERENCES

1. Barnes P, Powell-Griner E, McFann K, Nahin R. Complementary and alternative medicine use among adults: United States, 2002. *Adv Data* 2004;343:1-19.
2. Barnes PM, Bloom B, Nahin RL. Complementary and alternative medicine use among adults and children: United States, 2007. *Natl Health Stat Report* 2008;12:1-23.
3. Davis MA, Sirovich BE, Weeks WB. Utilization and expenditures on chiropractic care in the United States from 1997 to 2006. *Health Serv Res* 2010;45:748-61.
4. Wolinsky F, Liu L, Miller T, et al. The use of chiropractors by older adults in the United States. *Chiropr Osteopat* 2007;15:12.
5. Weigel P, Hockenberry JM, Bentler SE, et al. A longitudinal study of chiropractic use among older adults in the United States. *Chiropr Osteopat* 2010;18:34 <http://dx.doi.org/10.1186/1746-1340-18-34>.
6. Whedon JM, Song Y, Davis MA. Trends in the use and cost of chiropractic spinal manipulation under Medicare Part B. *Spine J* 2013;13:1449-54.
7. Wolsko PM, Eisenberg DM, Davis RB, Kessler R, Phillips RS. Patterns and perceptions of care for treatment of back and neck pain: results of a national survey. *Spine* 2003;28:292-7 [discussion 298].
8. Lavsky-Shulan M, Wallace RB, Kohout FJ, Lemke JH, Morris MC, Smith IM. Prevalence and functional correlates of low back pain in the elderly: the Iowa 65+ Rural Health Study. *J Am Geriatr Soc* 1985;33:23-8.
9. Coulter I, Hurwitz E, Adams A, Genovese B, Hays R, Shekelle P. Patients using chiropractors in North America: who are they, and why are they in chiropractic care? *Spine* 2002;27:291-6.
10. Cayea D, Perera S, Weiner DK. Chronic low back pain in older adults: what physicians know, what they think they know, and what they should be taught. *J Am Geriatr Soc* 2006;54:1772-7.
11. Weiner DK, Haggerty CL, Kritchovsky SB, et al. How does low back pain impact physical function in independent, well-functioning older adults? Evidence from the Health ABC Cohort and implications for the future. *Pain Med* 2003;4:311-20.
12. Weiner DK, Kim YS, Bonino P, Wang T. Low back pain in older adults: are we utilizing healthcare resources wisely? *Pain Med* 2006;7:143-50.
13. Deyo RA, Mirza SK, Martin BI. Back pain prevalence and visit rates: estimates from U.S. national surveys, 2002. *Spine* 2006;31:2724-7.
14. Hart LG, Deyo RA, Cherkin DC. Physician office visits for low back pain. Frequency, clinical evaluation, and treatment patterns from a U.S. national survey. *Spine* 1995;20:11-9.
15. Martin BI, Deyo RA, Mirza SK, et al. Expenditures and health status among adults with back and neck problems. *JAMA* 2008;299:656-64.
16. Deyo RA, Mirza SK, Turner JA, Martin BI. Overtreating chronic back pain: time to back off? *J Am Board Fam Med* 2009;22:62-8.
17. Buchman AS, Shah RC, Leurgans SE, Boyle PA, Wilson RS, Bennett DA. Musculoskeletal pain and incident disability in community-dwelling older adults. *Arthritis Care Res* 2010;62:1287-93.
18. Wolinsky FD, Bentler SE, Hockenberry J, et al. Long-term declines in ADLs, IADLs, and mobility among older Medicare beneficiaries. *BMC Geriatr* 2011;11:43-55.
19. Leveille SG, Guralnik JM, Hochberg M, et al. Low back pain and disability in older women: independent association with difficulty but not inability to perform daily activities. *J Gerontol A Biol Sci Med Sci* 1999;54:M487-93.
20. Weiner DK, Rudy TE, Kim YS, Golla S. Do medical factors predict disability in older adults with persistent low back pain? *Pain* 2004;112:214-20.
21. Scudds RJ, Mc DRJ. Empirical evidence of the association between the presence of musculoskeletal pain and physical disability in community-dwelling senior citizens. *Pain* 1998;75:229-35.

22. Scudds RJ, Robertson JM. Pain factors associated with physical disability in a sample of community-dwelling senior citizens. *J Gerontol A Biol Sci Med Sci* 2000;55:M393-9.
23. Friedly J, Chan L, Deyo R. Increases in lumbosacral injections in the Medicare population: 1994 to 2001. *Spine* 2007;32:1754-60.
24. Manchikanti L, Pampati V, Boswell MV, Smith HS, Hirsch JA. Analysis of the growth of epidural injections and costs in the Medicare population: a comparative evaluation of 1997, 2002, and 2006 data. *Pain Physician* 2010;13:199-212.
25. Weinstein JN, Lurie JD, Olson PR, Bronner KK, Fisher ES. United States' trends and regional variations in lumbar spine surgery: 1992-2003. *Spine* 2006;31:2707-14.
26. Whedon JM, Davis MA. Medicare part B claims for chiropractic spinal manipulation, 1998 to 2004. *J Manipulative Physiol Ther* 2010;33:558-61.
27. Weigel PA, Hockenberry J, Bentler SE, Wolinsky FD. The comparative effect of episodes of chiropractic and medical treatment on the health of older adults. *J Manipulative Physiol Ther* 2014;37:143-54.
28. Miller EA, Weissert WG. Predicting elderly people's risk for nursing home placement, hospitalization, functional impairment, and mortality: a synthesis. *Med Care Res Rev* 2000;57:259-97.
29. Wolinsky FD, Callahan CM, Fitzgerald JF, Johnson RJ. The risk of nursing home placement and subsequent death among older adults. *J Gerontol* 1992;47:S173-82.
30. Health and health care of the Medicare population: data from the Medicare Current Beneficiary Survey. Rockville, MD: Westat; 2003.
31. Adler GS. A profile of the Medicare Current Beneficiary Survey. *Health Care Financ Rev* 1994;15:153-63.
32. The Centers for Medicare and Medicaid Services. Medicare Current Beneficiary Survey (MCBS). Department of Health and Human Services, Washington, DC. <http://www.cms.gov/Research-Statistics-Data-and-Systems/Research/MCBS/index.html>. Accessed May 2012.
33. Weigel PA, Hockenberry JM, Bentler SE, Kaskie B, Wolinsky FD. Chiropractic episodes and the co-occurrence of chiropractic and health services use among older Medicare beneficiaries. *J Manipulative Physiol Ther* 2012;35:168-75.
34. Aday LA, Andersen RM. Models of Health Care Utilization and Behavior. In: Armitage P, Colton T, editors. *Encyclopedia of Biostatistics*. John Wiley & Sons, Ltd.; 2005
35. Andersen R. Revisiting the behavioral model and access to medical care: does it matter? *J Health Soc Behav* 1995;36:1-10.
36. Shadish WR, Steiner PM. A primer on propensity score analysis. *Newborn Infant Nurs Rev* 2010;10:19-26.
37. D'Agostino RB. Propensity score methods for bias reduction in the comparison of a treatment to a non-randomized control group. *Stat Med* 1998;17:2265-81.
38. Freedman DA, Berk RA. Weighting regressions by propensity scores. *Eval Rev* 2008;32:392-409.
39. Rosenbaum PR, Rubin DB. The central role of the propensity score in observational studies for causal effects. *Biometrika* 1983;70:41-55.
40. Weigel PA, Hockenberry J, Bentler S, Wolinsky FD. Chiropractic use and changes in health among older Medicare beneficiaries: a comparative effectiveness observational study. *J Manipulative Physiol Ther* 2013;36:572-84.
41. Whedon JM, Song Y. Geographic variations in availability and use of chiropractic under Medicare. *J Manipulative Physiol Ther* 2012;35:101-9.
42. Whedon JM, Song Y, Davis MA, Lurie JD. Use of chiropractic spinal manipulation in older adults is strongly correlated with supply. *Spine* 2012;37:1771-7.
43. Inspector General. Chiropractic services in the Medicare program: payment vulnerability analysis. Washington, DC: Office of Inspector General; 2005 [OEI-09-02-00530].
44. Haas M, Group E, Kraemer DF. Dose-response for chiropractic care of chronic low back pain. *Spine J* 2004;4:574-83.
45. Descarreaux M, Blouin JS, Drolet M, Papadimitriou S, Teasdale N. Efficacy of preventive spinal manipulation for chronic low-back pain and related disabilities: a preliminary study. *J Manipulative Physiol Ther* 2004;27:509-14.
46. Hondras MA, Long CR, Cao Y, Rowell RM, Meeker WC. A randomized controlled trial comparing 2 types of spinal manipulation and minimal conservative medical care for adults 55 years and older with subacute or chronic low back pain. *J Manipulative Physiol Ther* 2009;32:330-43.

APPENDIX I. SPINE-RELATED CONDITION *ICD-9-CM* CODES USED TO SELECT INTO SAMPLES

Category	Description
Dorsopathies—spondylosis and allied disorders	
721.0	Cervical spondylosis without myelopathy
721.1	Cervical spondylosis with myelopathy
721.2	Thoracic spondylosis without myelopathy
721.3	Lumbosacral spondylosis without myelopathy
721.4	Thoracic or lumbar spondylosis with myelopathy
721.5	Kissing spine; Baastrup syndrome
721.6	Ankylosing vertebral hyperostosis
721.7	Traumatic spondylopathy; Kummell disease or spondylitis
721.8	Other allied disorders of spine
721.9	Spondylosis of unspecified site
Dorsopathies—intervertebral disk disorders	
722.1	Displacement of thoracic or lumbar intervertebral disk without myelopathy
722.2	Displacement of intervertebral disk, site unspecified, without myelopathy
722.4	Degeneration of cervical intervertebral disk
722.5	Degeneration of thoracic or lumbar intervertebral disk
722.6	Degeneration of intervertebral disk, site unspecified
722.7	Intervertebral disk disorder with myelopathy
722.8	Postlaminectomy syndrome
722.9	Other and unspecified disk disorder; calcification of intervertebral cartilage or disk discitis
Dorsopathies—other disorder of cervical region	
723.0	Spinal stenosis of cervical region
723.1	Cervicalgia
723.2	Cervicocranial syndrome
723.3	Cervicobrachial syndrome (diffuse)
723.4	Brachia neuritis or radiculitis NOS
Dorsopathies—other and unspecified disorders of back	
724	Other and unspecified disorders of back
Osteopathies, chondropathies, and acquired musculoskeletal deformities	
738.2	Acquired deformity of neck
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	
739.1	Cervical region
739.2	Thoracic region
739.3	Lumbar region
739.4	Sacral region
Dislocation—other, multiple, and ill-defined dislocations	
839.0	Cervical vertebra, closed
839.1	Cervical vertebra, open
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	
847.0	Neck
847.1	Thoracic
847.2	Lumbar
847.3	Sacrum
847.4	Coccyx
847.9	Unspecified site of back

NOS, not otherwise specified.