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Chiropractic Use and Changes in Health among Older Medicare Beneficiaries: A Comparative Effectiveness Observational Study

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Abstract

Objective—The purpose of this study was to investigate the effect of chiropractic on five outcomes among Medicare beneficiaries: increased difficulties performing Activities of Daily Living (ADLs), Instrumental ADLs (IADLs), and Lower Body Functions, as well as lower self-rated health and increased depressive symptoms.

Methods—Among all beneficiaries, we estimated the effect of chiropractic use on changes in health outcomes among those who used chiropractic compared to those who did not, and among beneficiaries with back conditions we estimated the effect of chiropractic use relative to medical care, both over a 2–15 year period. Two analytic approaches were used—one assumed no selection bias, while the other adjusted for potential selection bias using propensity score methods.

Results—Among all beneficiaries, propensity score analyses indicated that chiropractic use led to comparable outcomes for ADLs, IADLs, and depressive symptoms, although there were increased risks associated with chiropractic for declines in lower body function and self-rated health. Propensity score analyses among beneficiaries with back conditions indicated that chiropractic use led to comparable outcomes for ADLs, IADLs, lower body function, and

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No conflicts of interest were reported for this study.

depressive symptoms, although there was an increased risk associated with chiropractic use for declines in self-rated health.

Conclusion—The evidence in this study suggests that chiropractic treatment has comparable effects on functional outcomes when compared to medical treatment for all Medicare beneficiaries, but increased risk for declines in self-rated health among beneficiaries with back conditions.

Keywords

Chiropractic; Medicare; Aged; Activities of Daily Living

Introduction

Chiropractic services were added as Medicare benefits in 1972 under amendments to the Social Security Act (1). The amendments authorized spinal manipulation treatments by Doctors of Chiropractic (DC) to correct spinal subluxations that cause significant neuromusculoskeletal health problems (2). Within the context of Medicare policy, subluxation is defined as "a motion segment, in which alignment, movement integrity, and/or physiological function of the spine are altered although contact between join surfaces remains intact." (2) Chiropractic therapy is expected to arrest the progression of functional decline or in the case of acute subluxations, restore and possibly improve patient function. Medicare coverage includes chiropractic services as treatment options for beneficiaries with spine-related health conditions under the proviso that such treatment is covered only if and as long as chiropractic therapy is expected to reduce disability and/or preserve function. Despite the fact that Medicare expenditures for chiropractic services were $1.6 billion between 2009 and 2011 alone (3–5), no study of which we are aware has investigated whether chiropractic has had the intended effect on health outcomes. Policies that target the functional health of older adults have important and far-reaching effects on other health priorities, including quality of life and healthcare spending. While several studies document older persons' preferences for home and community based care vs. institutional settings for their long-term care needs (6–8), placement in institutional settings like nursing homes is often determined by a person's degree of disability (9, 10). Functional disability is reflected by a person's capacity to perform everyday tasks, typically in community based settings, and is routinely measured by difficulties performing Activities of Daily Living (ADLs) (11, 12), Instrumental ADLs (IADLs) (13), and lower body mobility (because it affects ADLs and IADLs). In a thorough review of the risks associated with nursing home placement, Miller, Weissert, et al (14) found that greater difficulties with ADLs, IADLs, and lower body mobility were significantly and consistently associated with the risk of institutionalization. Thus, intervening early with therapies that slow functional decline may enable individuals to maintain their autonomy and reduce their risk of institutionalization.

Additionally, research on the relationships between functional health, self-rated health, and depressive symptoms in older adults paints a complex picture of their etiologic pathways. Activity restriction and functional disability have been shown to contribute to depressive symptoms and lower self-rated health, while increasing levels of depressive symptoms have been shown to predict greater decline in physical performance (15–22). These studies conclude that reducing functional difficulties may alleviate depressive symptoms and enhance self-rated health. Thus, chiropractic may have an indirect beneficial effect on self-rated health and depressive symptoms through its direct therapeutic impact on physical symptoms and function. Just as greater levels of ADL and IADL difficulty predict nursing home placement, these same functional difficulties also predict higher Medicare-covered health services use, including paid home care, physician services, and hospital care (10, 14, 23). Moreover, as the primary insurer for long-term care services and supports, Medicaid

uses functional impairment as an eligibility criterion for the provision of home and community based services, as well as for nursing home placement. With Medicaid long-term care services and supports expenditures exceeding $123 billion in 2010, two thirds of which (24) was spent on beneficiaries over age 65, policy makers have a financial incentive to encourage the use of interventions that slow the rate of functional decline in older persons.

Back-related musculoskeletal problems are a major source of functional and mobility limitations in older adults, and are one of the most common health complaints presented to health care providers (25). Among older adults, prevalence estimates for back-related musculoskeletal problems range from 23–33% (26–28). There is a large body of research demonstrating evidence of chiropractic effectiveness in the general population (29–37), and chiropractic is recommended by the American College of Physicians and the American Pain Society for patients with back conditions that do not improve after self-care (38). The American College of Physicians and the American Pain Society evidence-based guidelines endorsing chiropractic for nonspecific back conditions notwithstanding, pharmacologic, imaging, and interventional treatments for these conditions have doubled over the past 15 years with no appreciable improvement in health outcomes (25). To promote the optimal use of health care resources, it is necessary to objectively determine which everyday practice therapies result in better benefits reflected in functional abilities, self-rated health, and depressive symptoms.

Although the literature on chiropractic provides good evidence of its efficacy, there are limitations. While some studies have characterized chiropractic use patterns, risk factors for use, and regional variation among Medicare beneficiaries (39–44), only a few studies have examined chiropractic effectiveness among older beneficiaries (> 70 years) (45–48). Older adults are an important population because they have a relatively high prevalence of back-related indications and thus are at increased risk of disability, and because Medicare benefits are primarily available for older adults. Furthermore, given the obstacles to randomizing patients to treatment options, few clinical trials have been conducted that compare chiropractic to traditional medical therapies. Moreover, among clinical trials that have made such comparisons, the follow-up periods have been quite short (e.g., less than 24 weeks) and the study populations have been relatively healthy (37). Among the observational studies that compare chiropractic to medical therapies, few have tried to remediate the potential for selection bias (due to the lack of randomizing chiropractic use), which weakens the internal validity of the study results. Finally, we are aware of no studies of older adults seeking care in real world practice settings that have examined the effects of chiropractic on functional outcomes for more than one year, or included self-rated health and/or depressive symptoms.

Because spinal manipulation therapy addresses spinal subluxations (as defined by Medicare) that cause neuromusculoskeletal conditions, we hypothesize that chiropractic care, when compared to no chiropractic use and other medical services, corrects underlying mechanical dysfunctions that consequently confer protection against declines in function, self-rated health, and against increases in depressive symptoms.

The purpose of this study is to determine whether chiropractic performs better, about the same, or worse than no use or other medical care in preserving or improving function and well-being among Medicare beneficiaries over two to fifteen years. We conducted two analyses to investigate this objective: first, among all Medicare beneficiaries in a nationally representative sample of community dwelling older adults, we investigated the impact of chiropractic use compared to no use on declines in functional status, self-rated health, and depressive symptoms. This yields the comparative effect of chiropractic use on health relative to non-use in the broad population. Second, among Medicare beneficiaries with back conditions, we investigated the effect of chiropractic use relative to medical care on

functional declines, self-rated health, and depressive symptoms. This yields the comparative effect of chiropractic on health relative to other forms of medical treatment for patients seeking care for back-related conditions, a more relevant metric for policy makers.

Methods

Study cohort and sample selection

Interview data from the nationally representative Survey on Assets and Health Dynamics among the Oldest Old (AHEAD) study were linked to survey participant Medicare claims. AHEAD is a longitudinal survey conducted by the Survey Research Center (SRC) at the University of Michigan (http://hrsonline.isr.umich.edu) and is publicly available. Medicare Part A and B claims for the AHEAD participants are not publicly available. However, these restricted data can be obtained by investigators funded for such analyses by the National Institutes of Health upon completion and approval of a Restricted Data Application (RDA) to the University of Michigan Survey Research Center, and subsequent completion and approval of a Data Use Agreement (DUA) with the Centers for Medicare and Medicaid Services (CMS). Following this procedure (RDA 2003–006, DUA 14807), we obtained access to the Medicare claims for the AHEAD respondents and linked their Part B claims to their survey interview data using an encrypted beneficiary number. This allowed us to observe transitions in physical, functional, and cognitive health states among older Americans, and how those changes were associated with certain health services use. Additional documentation concerning the AHEAD, including its objectives, survey design, and description of the data can be found elsewhere (49–52).

The AHEAD participants were 70 years old or older at their baseline interviews in 1993–1994, and were re-interviewed biennially thereafter. We used the baseline and follow-up interviews through 2006–2007 linked to Medicare's Carrier Claims (non-institutional provider services) Standard Analytic File between 1993 and 2007. Of the 7,447 original AHEAD participants, 774 did not provide consent to have their survey data linked to their Medicare claims, and 28 consenting participants had linkage errors. Another 774 participants had no follow-up interviews after baseline, either because of dying before the 1995–1996 follow-up interview or other reasons. The final analytic sample for the first analysis (examining the effect on health of chiropractic use vs. no use among all beneficiaries) is the 5,871 AHEAD self- or proxy-respondents (78.8% of the original sample) having at least two surveys between 1993 and 2007, and a successful linkage of the survey data and Medicare claims.

The second analysis (examining the effect on health of chiropractic care vs. medical care among beneficiaries with back conditions) was restricted to AHEAD participants having back-related musculoskeletal conditions. These individuals were identified from the Medicare Carrier Claims Standard Analytic File using *International Classification of Diseases, Ninth Revision, Clinical Modification* (ICD-9-CM) diagnosis codes indicating clinical presentation of a back-related problem at any time between their first and last survey interviews. From the claims analysis we identified 3,518 individuals (60% of all beneficiaries) having at least one back-related visit to either a DC or MD during their time in the study. The ICD-9-CM codes were taken from a prior study of conditions for which patients commonly presented to either chiropractic or medical providers for back-related health issues, and are shown in Table 1 (44).

The comparison groups in the first analysis were defined by whether an individual used chiropractic at any time between first and last survey interview or not, where chiropractic use was identified from Medicare Part B Carrier Claims indicating a visit to a DC (a code of '35' in the provider specialty field). In the second analysis of the back condition cohort,

chiropractic users were again identified by having at least one visit to a DC while the comparison group had visits only to medical doctors, including (but not limited to) internists, family practitioners, orthopaedists, neurologists, and interventional pain physicians.

Outcome assessment

There were five outcome measures for each analytic sample, three indicating functional ability and two reflecting quality of life. In assessing the broadest impact of chiropractic on physical function, we used three standard measures of physical functional status: the number of difficulties performing five activities of daily living (ADL), five instrumental activities of daily living (IADL), and four measures of lower body function. The five ADL items were getting across a room, dressing, bathing or showering, eating, and getting in or out of bed. The five IADL items were using a telephone, taking medication, handling money, shopping, and preparing meals. The four lower body function items were climbing up and down one flight of stairs, walking several blocks, pushing and/or pulling heavy objects, and lifting or carrying ten pounds or more. Declines in each of these physical function outcomes were defined as an increase of two or more limitations between the first and last interview, based on suggestions in the gerontologic literature (52–54) that this amount of change is both personally and clinically meaningful.

The two quality of life outcomes were measured by declines over time in self-rated health and increased numbers of depressive symptoms between the first and last interviews. Because proxy-respondents were not asked the depressive symptoms questions, only self-respondents were included in those analyses.

Covariates

Building on recent research identifying (a) risk factors for long-term functional decline in older adults (52), (b) risk factors for chiropractic use in older adults (42, 43), and by (c) the Andersen and A day behavioral model of health services use (55–57), we included a comprehensive set of covariates. These independent covariates were collected at baseline and included demographic and socio-economic factors such as age, race, marital status, educational attainment and income; disease history and comorbidity status, such as whether an individual was ever told they had angina, arthritis, cancer, diabetes, heart attack, hip fracture, hypertension, lung disease, psychological problems, and stroke; health status measures indicating vision and hearing ability, functional ability, whether the participant experiences pain or not, their self-rated health, and depressive symptoms (if a self-respondent); lifestyle-related factors, such as whether the participant engages in vigorous activity or not, body mass index, smoking and daily alcohol consumption status; health services use as indicated by a participant's quartile in the study sample distribution of pre-baseline annual hospitalizations, and continuity of care (always or never); the number of years between the baseline and final survey interview, time to death after the final interview, and respondent status indicators at baseline and the final interview (self-respondent vs. proxy). Detailed information about the covariate coding algorithms may be found in Wolinsky et al (52).

Analysis

We estimated the comparative effect of chiropractic on each of the five binary outcomes in two ways for both cohorts. The first used simple multivariable logistic regression and assumed that there was no selection bias into chiropractic use. The second approach incorporated propensity score methods that recognize that there may be selection bias into chiropractic use, a common problem in observational studies (58–61).

Specifically, the approach recognizing the potential for selection bias used propensity score weighted regression analysis (60–65). By modeling the chiropractic use selection process using all observable and theoretically-relevant covariates, and then using the inverse probabilities of estimated chiropractic use to weight the outcome regression model itself, the unbiased effect of chiropractic use on health is estimated, similar to what random assignment to treatment group would achieve. In addition to the covariates in the outcome models, we also included in the selection to chiropractic use logistic regression model state-level chiropractor supply measures normalized to state populations at baseline (both general and over-65). We included these variables as predictors of chiropractic use because recent evidence has shown chiropractic use among Medicare beneficiaries is strongly correlated with chiropractor supply (40, 41). The state-level, active chiropractor supply data were obtained from the annual Directories published by the Federation of Chiropractic Licensing Boards (FCLB, http://directory.fclb.org), and state population data were obtained by aggregating county-level data from the Area Resource File (ARF, http://arf.hrsa.gov) to the state level. The supply variables were then linked to participants by state of residence at baseline. Furthermore, we included county-level variables from the Area Resource File indicating metro-rural designation of county of residence, median household income at the county level, and percent of poverty in the county. These variables were linked to survey data by participant's county of residence at baseline. To obtain the best estimates of propensity scores possible with our data, we then estimated several models of selection to chiropractic use. Our best fitting model had a C-statistic of 0.69 and a Hosmer-Lemeshow goodness of fit p value of 0.94, indicating a good fit of the model to the data. Using the propensity scores (estimated probability of chiropractic use, p) from this model, we derived propensity score weights defined as $1/p$ for chiropractic users and $1/(1-p)$ for non-chiropractic users. We then adjusted the propensity score weights by baseline covariate cell sizes in each comparison group, and subsequently estimated the outcome models again using multivariable logistic regression weighted by the inverse of each individual's adjusted propensity score.

Human subject approvals

This research was supported by grants R01 AG022913 and R21 AT004578 from the National Institutes of Health (NIH) awarded 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 2013. Written informed consent was obtained from all AHEAD participants.

Results

Descriptives

Among the 5,871 Medicare beneficiaries in the AHEAD, there were 750 users of chiropractic (12.8%). Significant differences between chiropractic users and non-users were evident at baseline as shown in Table 2. A comparison of baseline means shows differences between the groups that indicated the chiropractic user population was generally healthier than the non-user population. Chiropractic users were significantly younger and more likely to be white, married, have higher education, and be in the upper income quintiles. A lower proportion of chiropractic users had chronic diseases or hip fractures. Chiropractic users also had fewer functional limitations and fewer depressive symptoms at baseline than non-users. Furthermore, vision and hearing were significantly better in the chiropractic group, as was baseline self-rated health. A higher proportion of chiropractic users were also engaged in

vigorous activity, but were also overweight. Fewer chiropractic users were current cigarette smokers.

In terms of health service use and continuity of care, chiropractic users had higher levels of hospitalization at baseline, and were more likely to have some continuity of care. Proportionately fewer chiropractic users died within twelve months of their last interview, or died before the end of the study period. A lower proportion had been in managed care, and a higher proportion of chiropractic users were self-respondents at both their first and last interviews. Chiropractic users remained in the study longer than non-users, with a mean of 9.82 years vs. 7.84 years.

Also shown in Table 2 are baseline means and proportions for the beneficiaries with back conditions. Among the 3,518 individuals in this subset, 741 were chiropractic users (21.1%). Significant differences were only observed between users and non-users for arthritis (a higher proportion of non-users with a back condition reported having arthritis) and for having > 1 alcoholic drink(s) daily (a higher proportion of drinking was found among chiropractic users). Of the five outcomes for all beneficiaries, functional declines occurred for 36% on ADLs, 32% on IADLs, and 31% on lower body function. Twelve percent declined in self-rated health, and 43% had more depressive symptoms by their last interview. A lower proportion of chiropractic users declined in IADLs relative to non-users, while a higher proportion of chiropractic users declined in lower body function. There were no significant differences between the groups in declines in ADLs, self-rated health, or depressive symptoms.

Of the five outcomes among beneficiaries who had back conditions, functional declines occurred for 41% on ADLs, 36% on IADLs, and 34% on lower body function. Eleven percent declined in self-rated health, and 46% had more depressive symptoms. A lower proportion of chiropractic users declined on ADLs and IADLs. There were no differences between the groups on declines in lower body function, self-rated health, or additional depressive symptoms.

Main Model Results

Table 3 shows the adjusted odds ratios (AORs) with 95% confidence intervals among all AHEAD beneficiaries for the effect of chiropractic use vs. no chiropractic use, and among AHEAD beneficiaries with back conditions for the effect of chiropractic use vs. medical care on each of the five health outcomes, respectively, when the potential for selection bias is not taken into consideration. Among all beneficiaries, chiropractic use had neither a beneficial nor harmful association with functional decline or quality of life, although the effect on ADL declines approached significance (p-value = 0.06). In the analysis of beneficiaries with back conditions, chiropractic had a protective effect against declines in ADLs relative to medical care. The adjusted odds ratio of 0.824 suggests a 17.6% reduction in the odds of a chiropractic user experiencing declines in ADLs relative to a non-user.

Propensity Score Model Results

Compared to the initial differences in group means and proportions shown in Table 1, the propensity score weighted data achieved covariate balance between groups for all beneficiaries, and for beneficiaries with back conditions (Table 4). Balance was indicated by *d* scores (the absolute value of the standardized mean difference) less than 0.10, and variance ratios between 0.8 and 1.20 (62) between the chiropractic use vs. non-use groups on the observed baseline covariates.

Table 5 shows the adjusted odds ratios (AORs) with 95% confidence intervals among all AHEAD beneficiaries for the effect of chiropractic use vs. no chiropractic use, and among AHEAD beneficiaries with back conditions for the effect of chiropractic use vs. medical care on each of the five health outcomes, respectively, when propensity score methods were used to address the potential for selection bias. Among all beneficiaries, chiropractic users had higher odds of experiencing a decline in lower body function (AOR 1.274, p-value = 0.02) and self-rated health (AOR 1.580, p-value < 0.001) when compared to those not using any chiropractic. Among beneficiaries with back conditions, chiropractic users had higher odds of experiencing declines in self-rated health (AOR 1.493, p-value < 0.01) when compared to those using medical services, but there were no significant effects of chiropractic use on declines in ADLs or IADLs, or in increased depressive symptoms.

Complete model results (including the effects for all of the covariates) are available from the first author.

Discussion

Using a representative sample of older Medicare beneficiaries, we examined the long-term effects of chiropractic use relative to non-use among all beneficiaries, and of chiropractic compared to medical care among beneficiaries with back conditions on five health outcomes. The five outcomes represented functional health and quality of life trajectories. Without adjusting for potential selection bias, our results suggest that chiropractic provided significant protection against long-term declines in ADLs when the analysis was limited to beneficiaries with back conditions. ADLs are an important functional measure in older populations that have implications for autonomy as well as health services use and expenditures. After adjustment for potential selection bias, however, our results suggest that chiropractic users had greater risk for declines in lower body function and self-rated health, but that there were no significant effects for chiropractic use on declines in ADLs or IADLs, or in increased depressive symptoms. Among beneficiaries with back conditions, after adjusting for potential selection bias, the results indicated that chiropractic users had an increased risk of decline in self-rated health, but were comparable to those receiving medical care instead of chiropractic on declines in ADLs, IADLs, lower body function, and increased depressive symptoms.

On the one hand, the protective effect of chiropractic against declines in ADLs among beneficiaries with back conditions is consistent with our hypothesis that chiropractic confers therapeutic benefits to patients with back conditions through hands-on spinal manipulation. This is not surprising given chiropractic's focus on restoring and maintaining a person's capacity to move—whether across a room, to dress, bathe or shower, or get in and out of bed. Slowing the progression of ADL decline may arguably be more important than doing so for the other functional measures, as ADL difficulties are a critical last barrier between independence and dependence. This protection, however, was only statistically significant among beneficiaries with back conditions when the potential for selection bias was ignored (although the effect size was comparable when adjustments for potential selection bias were made).

On the other hand, the increased risk associated with chiropractic use for declines in lower body function among all beneficiaries using the propensity score approach was unexpected. Although not statistically significant in the other models, the adjusted odds ratios were comparable, suggesting increased risk. Understanding which lower body function components (e.g., climbing up and down 1 flight of stairs or walking several blocks) are most associated (for better or worse) with chiropractic use should be the focus of future work.

Similarly, the increased risk of chiropractic with declines in self-rated health under the propensity score approach was also not anticipated. This unanticipated effect might be explained by individuals experiencing progressive health declines between surveys, and thereby perceiving a greater deterioration in self-rated health over the same period. Other studies have shown that changes in functional health or disability influence perceptions of self-rated health (22). Therefore, we conducted *post-hoc* analyses that added measures of functional decline to the self-rated health models. The *post-hoc* results revealed an even *higher* risk of self-rated decline for those using chiropractic after the effects of decline in ADLs, IADLs, and lower body function were included. What we did not explore in our *post-hoc* analyses, however, was the effect of additional hospitalizations between first and last interviews. Comparisons of hospitalization means at baseline indicated that proportionately more chiropractic users fell into higher categories of hospitalization use, which could indicate the presence of other serious health conditions affecting health over time that were not adjusted for in our models. These results merit further investigation.

Limitations

Two limitations of this work warrant mention. The first is related to data and modeling. While attempts were made to address potential selection bias through the use of propensity score methods, the technique may not have worked as intended. While we achieved balance on observable confounders, we cannot ensure that all potential unobserved confounders were removed from the effect of chiropractic on declines in function and quality of life. Propensity score methods require assumptions about the selection process that are difficult to validate, such as identification of all important factors influencing choice, and without better measures reflecting how and why people decide to use chiropractic, our estimated propensity scores (and consequent weights) may be imprecise. Furthermore, variables constructed for use in the selection to chiropractic model may be inaccurate. The chiropractor supply data obtained from the Federation of Chiropractic Licensing Boards may not accurately reflect the true supply of chiropractors under Medicare, and the supply of chiropractors per state capita likely changed over the study window, both of which could affect the estimated propensity to use chiropractic. Therefore, the propensity score models should be viewed in the context of the unadjusted results, which reflected similar effect sizes that did not reach statistical significance.

The second limitation is that our chiropractic treatment measure reflects whether a person used chiropractic over the study period or not, but it does not reflect the severity or chronicity of their condition, the timing of use relative to survey interviews, nor the intensity of treatment within an episode of care. The inability to appropriately risk adjust the chiropractic user group by condition or treatment intensity may lead to bias to the null if infrequent, sub-acute condition chiropractic users are mixed with high-frequent, chronic condition users. Evidence from the chiropractic literature suggests that there is a ‘dosing’ level that must be reached for chiropractic to show efficacy in reducing disability and/or restoring function. In this study we did not examine whether the minimum dosing level (e.g., had six or more visits within an episode of back-related care) had been received. Future work should characterize back conditions and dosing frequencies to further risk adjust the comparison groups and refine the comparative effect detection ability of chiropractic use on health.

Clinical and policy applications and suggestions for future research—This study is the first to examine the long-term comparative effects of chiropractic use on functional decline and quality of life changes among community dwelling Medicare beneficiaries. In the most policy-relevant analysis among older individuals seeking care for back conditions, our results (without adjusting for potential selection bias) indicate that at

best there is a modest protective effect of chiropractic against developing declines in ADL function. At worst, our results indicate that the only functional outcome for which statistically significant poorer outcomes were associated with chiropractic care involved lower body function. In essence, from the standpoint of functional outcomes chiropractic and medical care yielded equivalent results.

This is also the first study to examine the long-term comparative effects of chiropractic use on quality of life among community dwelling Medicare beneficiaries. Of the two quality of life measures, a significant effect was only observed on self-rated health. Here, chiropractic was associated with increased risks for declines in self-rated health relative to medical care for those with back conditions. This unexpected result warrants additional research into factors mediating the chiropractic-self-rated health relationship.

Conclusion

The evidence in this study suggests that chiropractic treatment has comparable effects on functional outcomes when compared to medical treatment for all Medicare beneficiaries, but increased risk for declines in self-rated health among beneficiaries with back conditions.

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Practical Applications

- Chiropractic effect on functional outcomes were similar to the medical effect in older adults
- Chiropractic use was associated with increased risk of decline in self-rated health among older adults
- Chiropractic had no association with changes in depressive symptoms among older adults

Table 1

International Classification of Diseases, 9th edition, Clinical Modification

(ICD-9-CM) three-digit diagnosis codes used to identify back conditions for which chiropractic or traditional medical care may be received

ICD-9-CM Group	Description
719	Arthropathies and related disorders—other and unspecified disorders of joint
721	Dorsopathies – spondylosis and allied disorders
722	Dorsopathies – intervertebral disc disorders
724	Dorsopathies – other and unspecified disorders of back
738	Osteopathies, chondropathies, and acquired musculoskeletal deformities
739	Osteopathies, chondropathies, and acquired musculoskeletal deformities, nonspecific – nonallopathic lesions not elsewhere classified
839	Dislocation – other, multiple, and ill-defined dislocations
846	Sprains and strains of joints and adjacent muscles – sacroiliac region
847	Sprains and strains of joints and adjacent muscles – other and unspecified parts of back

Table 2

Baseline means for users and non-users of chiropractic among all AHEAD participants, and among those who had back conditions

	All AHEAD Participants (N=5,871)			AHEAD Participants with Back Conditions (N = 3,518)		
	Chiropractic Users (N=750)	Non-users (N=5,121)	p-value	Chiropractic Users (N = 741)	Non-users (N =2,777)	p-value
Demographic Factors						
Age	75.8	77.3	**<.0001**	75.7	77.0	**<.0001**
Male (%)	0.38	0.38	0.884	0.38	0.31	**<.0001**
Race (%)						
White	0.95	0.86	**<.0001**	0.95	0.87	**<.0001**
African American	0.02	0.10	**<.0001**	0.02	0.10	**<.0001**
Hispanic	0.03	0.04	0.102	0.03	0.04	0.1286
Marital Status (%)						
Married	0.64	0.51	**<.0001**	0.65	0.47	**<.0001**
Never Married	0.02	0.03	**0.007**	0.02	0.04	**0.006**
Separated/Divorced	0.04	0.05	0.37	0.04	0.05	0.324
Widowed	0.30	0.41	**<.0001**	0.30	0.44	**<.0001**
Socioeconomic Factors (%)						
Educational Attainment						
Grade School or Less	0.18	0.25	**<.0001**	0.17	0.24	**<.0001**
Some High School	0.14	0.17	**0.022**	0.14	0.17	0.071
High School	0.37	0.31	**0.0003**	0.37	0.31	**0.0004**
Some College	0.31	0.27	**0.024**	0.31	0.29	0.1404
Income						
IncomeQ1	0.07	0.15	**<.0001**	0.07	0.16	**<.0001**
IncomeQ2	0.24	0.29	**0.002**	0.24	0.29	**0.002**
IncomeQ3	0.12	0.14	0.494	0.12	0.13	0.720
IncomeQ4	0.23	0.19	**0.002**	0.23	0.18	**0.005**
IncomeQ5	0.34	0.23	**<.0001**	0.34	0.23	**<.0001**
Health Status Factors (%)						
3+ Comorbid Conditions	0.15	0.17	0.214	0.15	0.18	0.082
Angina	0.06	0.09	**0.018**	0.06	0.09	**0.004**

	All AHEAD Participants (N=5,871)			AHEAD Participants with Back Conditions (N = 3,518)		
	Chiropractic Users (N=750)	Non-users (N=5,121)	p-value	Chiropractic Users (N = 741)	Non-users (N =2,777)	p-value
Arthritis	0.25	0.24	0.699	0.25	0.29	**0.016**
Cancer	0.12	0.12	0.744	0.12	0.11	0.288
Diabetes	0.08	0.12	**0.009**	0.08	0.11	0.066
Heart Attack	0.05	0.07	**0.043**	0.05	0.07	0.054
Hip Fracture	0.02	0.05	**0.002**	0.02	0.05	**0.003**
Hypertension	0.41	0.45	**0.048**	0.41	0.45	0.051
Lung Disease	0.06	0.08	**0.023**	0.06	0.08	0.077
Psych Problems	0.07	0.06	0.349	0.07	0.07	0.996
Stroke	0.08	0.08	0.504	0.08	0.08	0.841
ADL Limitations (count)	0.15	0.33	**<.0001**	0.15	0.33	**<.0001**
IADL Limitations (count)	0.10	0.38	**<.0001**	0.10	0.33	**<.0001**
LBF Limitations (count)	0.88	1.25	**<.0001**	0.88	1.32	**<.0001**
Good Vision	0.83	0.75	**<.0001**	0.83	0.75	**<.0001**
Good Hearing	0.79	0.74	**0.009**	0.79	0.76	0.086
Depression Score (count)	1.26	1.59	**<.0001**	1.25	1.69	**<.0001**
Pain	0.33	0.32	0.548	0.33	0.37	0.0705
SRH Good or Better	0.76	0.66	**<.0001**	0.76	0.66	**<.0001**
Lifestyle Factors (%)						
Engages vigorous activity	0.41	0.29	**<.0001**	0.41	0.30	**<.0001**
Obese	0.12	0.14	0.164	0.13	0.15	**0.049**
Over weight	0.44	0.37	**0.0002**	0.44	0.38	**0.003**
Normal weight	0.43	0.46	0.067	0.43	0.44	0.377
Underweight	0.01	0.03	**0.010**	0.01	**0.03**	**0.029**
Former Smoker	0.43	0.42	0.421	0.44	0.39	**0.016**
Current Smoker	0.07	0.10	**0.023**	0.07	0.08	0.551
≥ 1 Alcoholic Drink Daily	0.13	0.11	0.099	0.13	0.11	**0.024**
Health Services Use (%)						
Hospitalizations						
No Hospitalizations	0.17	0.26	**<.0001**	0.16	0.14	0.153
0.01 to 0.23 Annually	0.31	0.25	**0.0006**	0.31	0.28	0.120

	All AHEAD Participants (N=5,871)			AHEAD Participants with Back Conditions (N = 3,518)		
	Chiropractic Users (N=750)	Non-users (N=5,121)	p-value	Chiropractic Users (N = 741)	Non-users (N =2,777)	p-value
0.24 to 0.50 Annually	0.32	0.28	**0.042**	0.32	0.32	0.887
> 0.50 Annually	0.21	0.22	0.832	0.21	0.26	**0.003**
Continuity of Care						
Continuity of Care - 100%	0.05	0.06	0.084	0.05	0.06	0.325
Continuity of Care - 0%	0.13	0.31	**<.0001**	0.13	0.18	**0.003**
Terminal Drop (%)						
Died within 1 year	0.24	0.31	**<.0001**	0.24	0.31	**0.0004**
Died after 1 year	0.28	0.38	**<.0001**	0.28	0.33	**0.005**
Managed Care Status (%)						
Ever in Managed Care	0.18	0.24	**0.001**	0.18	0.17	0.316
Respondent Status (%)						
Both Self Reports	0.82	0.70	**<.0001**	0.82	0.70	**<.0001**
Base Self & Final Proxy	0.15	0.22	**<.0001**	0.15	0.25	**<.0001**
Base Proxy & Final Self	0.02	0.02	0.964	0.02	0.01	0.214
Both Proxy Reports	0.02	0.06	**<.0001**	0.02	0.04	**0.002**
Time Between Survey Years						
Survey Years	9.82	7.84	**<.0001**	9.86	8.98	**<.0001**

Table 3

Adjusted Odds Ratios for the effect of chiropractic on declines in function and quality of life, without adjustment for potential selection bias into treatment modalities

Sample	Decline in Outcome				
	ADL	**IADL**	**Lower Body Function**	**Self-Rated Health**	**Depressive Symptoms**
Analysis among all AHEAD participants	0.839	0.930	1.140	1.298	1.072
95% CI	(0.698, 1.009)	(0.751, 1.150)	(0.941, 1.380)	(0.945, 1.783)	(0.896, 1.283)
Analysis among AHEAD participants with back conditions	**0.824***	0.952	1.097	1.329	0.998
95% CI	(0.680, 0.999)	(0.762, 1.190)	(0.897, 1.341)	(0.945, 1.870)	(0.828, 1.204)

* significant at the 0.05 level

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Table 4

Propensity score weight adjusted baseline covariates in full cohort and back condition samples

	Full Cohort (N = 5,871)				Back Condition Cohort (N = 3,518)			
	Chiropractic Users	Non- users	d	Variance Ratio	Chiropractic Users	Non- users	d	Variance Ratio
Demographic Factors								
Age	77.1	77.2	0	0.98	76.8	76.9	0.00	0.93
Male (%)	0.42	0.39	0.07	1.01	0.34	0.33	0.02	0.98
Race (%)								
White	0.83	0.81	0.04	0.92	0.86	0.83	0.09	0.81
African American	0.12	0.12	0.01	1.01	0.10	0.11	0.02	0.91
Hispanic	0.04	0.06	0.07	0.74	0.03	0.05	0.10	0.63
Marital Status (%)								
Married	0.57	0.53	0.09	0.97	0.55	0.52	0.08	0.95
Never Married	0.02	0.03	0.08	0.94	0.02	0.03	0.06	0.66
Separated/Divorced	0.06	0.05	0.02	1.07	0.05	0.05	0.04	0.82
Widowed	0.35	0.39	0.06	**0.66**	0.38	0.40	0.05	0.94
Socioeconomic Factors (%)								
Educational Attainment								
Grade School or Less	0.24	0.26	0.05	0.94	0.22	0.25	0.05	0.90
Some High School	0.13	0.17	0.10	0.81	0.14	0.17	0.07	0.84
High School	0.36	0.30	**0.14**	1.09	0.36	0.30	**0.14**	1.09
Some College	0.26	0.27	0.02	0.96	0.27	0.29	0.04	0.93
Income								
IncomeQ1	0.11	0.15	**0.13**	0.73	0.12	0.16	**0.11**	0.75
IncomeQ2	0.31	0.29	0.04	1.02	0.28	0.28	0.01	0.97
IncomeQ3	0.12	0.13	0.03	0.91	0.13	0.13	0.01	0.94
IncomeQ4	0.23	0.19	0.09	1.13	0.2	0.19	0.05	1.03
IncomeQ5	0.24	0.24	0	0.98	0.27	0.25	0.05	1.01
Health Status Factors (%)								
3+ Comorbid Conditions	0.19	0.17	0.04	1.05	0.19	0.18	0.04	1.02
Angina	0.08	0.09	0.03	0.9	0.09	0.09	0.01	0.93

	Full Cohort (N = 5,871)				Back Condition Cohort (N = 3,518)			
	Chiropractic Users	Non- users	d	Variance Ratio	Chiropractic Users	Non- users	d	Variance Ratio
Arthritis	0.24	0.25	0.01	0.97	0.29	0.29	0.01	0.97
Cancer	0.11	0.12	0.01	0.96	0.11	0.11	0.01	0.99
Diabetes	0.12	0.12	0.02	0.95	0.11	0.11	0.02	0.93
Heart Attack	0.05	0.07	0.07	0.75	0.05	0.07	0.05	0.78
Hip Fracture	0.05	0.04	0.05	**1.24**	0.07	0.04	0.10	**1.40**
Hypertension	0.42	0.45	0.06	0.97	0.44	0.45	0.02	0.96
Lung Disease	0.08	0.07	0.02	1.04	0.06	0.07	0.07	**0.76**
Psych Problems	0.07	0.06	0.02	1.07	0.07	0.07	0.01	1.00
Stroke	0.09	0.08	0.02	1.03	0.10	0.08	0.06	1.15
ADL Limitations (count)	0.3	0.31	0.02	0.76	0.25	0.31	0.08	**0.67**
IADL Limitations (count)	0.4	0.36	0.04	1.13	0.33	0.29	0.05	**1.24**
LBF Limitations (count)	1.18	1.23	0.03	0.94	1.23	1.24	0.01	0.90
Good Vision	0.76	0.75	0.02	0.96	0.77	0.75	0.05	0.91
Good Hearing	0.73	0.74	0.04	1.03	0.75	0.78	0.01	0.97
Depression Score (count)	1.56	1.59	0.01	1	1.54	1.63	0.05	0.95
Pain	0.32	0.33	0.03	0.96	0.36	0.36	0.00	0.96
SRH Good or Better	0.65	0.67	0.04	1.01	0.68	0.67	0.03	0.94
Lifestyle Factors (%)								
Engages vigorous activity	0.29	0.3	0.02	0.97	0.31	0.31	0.01	0.95
Obese	0.13	0.14	0.05	0.88	0.14	0.15	0.04	0.90
Over weight	0.53	0.38	0.11	1.03	0.42	0.39	0.07	0.99
Normal weight	0.41	0.45	0.09	0.96	0.41	0.44	0.06	0.94
Underweight	0.04	0.03	0.03	1.17	0.03	0.03	0.05	**1.27**
Former Smoker	0.44	0.43	0.03	0.99	0.41	0.40	0.02	0.97
Current Smoker	0.08	0.1	0.07	0.8	0.08	0.08	0.03	0.90
≥ 1 Alcoholic Drink Daily	0.1	0.11	0.02	0.93	0.10	0.11	0.02	0.91
Health Services Use (%)								
Hospitalizations								
No Hospitalizations	0.24	0.25	0.03	0.96	0.15	0.15	0.01	0.99

	Full Cohort (N = 5,871)				Back Condition Cohort (N = 3,518)			
	Chiropractic Users	Non- users	d	Variance Ratio	Chiropractic Users	Non- users	d	Variance Ratio
0.01 to 0.23 Annually	0.28	0.25	0.07	1.06	0.31	0.28	0.06	1.01
0.24 to 0.50 Annually	0.29	0.29	0.01	1	0.32	0.32	0.01	0.97
> 0.50 Annually	0.2	0.22	0.06	0.91	0.22	0.26	0.09	0.86
Continuity of Care								
Continuity of Care - 100%	0.05	0.06	0.05	0.81	0.05	0.06	0.02	0.88
Continuity of Care - 0%	0.19	0.31	**0.28**	0.71	0.15	0.18	0.08	0.84
Terminal Drop (%)								
Died within 1 year	0.31	0.32	0.01	0.98	0.32	0.30	0.04	0.99
Died after 1 year	0.31	0.38	0.15	0.89	0.28	0.33	0.10	0.88
Managed Care Status (%)								
Ever in Managed Care	0.27	0.24	0.06	1.06	0.19	0.18	0.01	0.97
Respondent Status (%)								
Both Self Reports	0.79	0.71	0	1	0.78	0.71	0.14	0.82
Base Self & Final Proxy	0.16	0.21	**0.15**	**0.77**	0.17	0.24	**0.17**	**0.74**
Base Proxy & Final Self	0.02	0.02	0	0.99	0.02	0.01	0.05	**1.41**
Both Proxy Reports	0.04	0.06	0.08	0.71	0.04	0.04	0.02	1.04
Time Between Survey Years								
Survey Years	8.9	7.85	**0.28**	0.94	9.12	9.02	0.03	1.06

Table 5

Adjusted Odds Ratios of estimated effect of chiropractic on declines in function and quality of life adjusted for potential selection bias into treatment modalities using the propensity score weighted regression model

Sample	Decline in Outcome				
	ADL	**IADL**	**Lower Body Function**	**Self-Rated Health**	**Depressive Symptoms**
Analysis among all AHEAD participants	0.867	0.935	**1.274***	**1.580*****	1.008
95% CI	(0.718, 1.047)	(0.752, 1.162)	(1.045, 1.553)	(1.199, 2.082)	(0.834, 1.217)
Analysis among AHEAD participants with back conditions	0.853	1.011	1.137	**1.493****	0.998
95% CI	(0.700, 1.039)	(0.809, 1.265)	(0.922, 1.403)	(1.095, 2.036)	(0.814, 1.199)

* significant at the 0.05 level

** significant at the 0.01 level

*** significant at the 0.001 level