

CHIROPRACTIC RESEARCH & PRACTICE

State of the Art

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State of the Art

Since chiropractic's breakthrough decade in the 1970s—when the U.S. federal government included chiropractic services in Medicare and federal workers' compensation coverage, approved the Council on Chiropractic Education (CCE) as the accrediting body for chiropractic colleges, and sponsored a National Institutes of Health (NIH) conference on the research status of spinal manipulation—the profession has grown and matured into an essential part of the nation's healthcare system.

Chiropractic was born in the United States in the late 19th century and the U.S. is home to approximately 65,000 of the world's 90,000 chiropractors.¹ The chiropractic profession is the third largest independent health profession in the Western world, after medicine and dentistry. Doctors of chiropractic are licensed throughout the English-speaking world and in many other nations as primary contact providers, licensed for both diagnosis and treatment without medical referral. In 2005, the World Health Organization (WHO) published *WHO Guidelines on Basic Training and Safety in Chiropractic*, which documented the status of chiropractic education and practice worldwide and sought to ensure high standards in nations where chiropractic is in the early stages of development.²

Rigorous educational standards are supervised by government-recognized accrediting agencies in many nations, including CCE in the United States. After fulfilling college science prerequisites similar to those required to enter medical schools, chiropractic students must complete a chiropractic college program of four academic years, which includes a wide range of courses in anatomy, physiology, pathology, and diagnosis, as well as spinal adjusting, physiotherapy, rehabilitation, public health and nutrition.

The NIH classifies chiropractic as a manipulation and body-based form of complementary and alternative medicine (CAM), although chiropractors, mindful of the major strides they have made toward mainstream status, more often prefer to be known as “integrative” rather than CAM practitioners.³ Utilization rates for both chiropractic and CAM are substantial. Chiropractors in the United States see approximately 19 million individual patients per year. At least one third of U.S. adults routinely use CAM therapies, and Americans schedule hundreds of millions of office visits per year to licensed CAM professionals, at a cost of tens of billions of dollars.⁴

Chiropractic shares with other CAM professions a health philosophy that emphasizes the inherent recuperative and self-healing capacities of the body, with a worldview based on promoting balance of body and mind through natural methods of prevention and treatment. Chiropractic is the only profession identified as CAM whose services are covered by a substantial majority of health insurance policies.

RESEARCH: CORNERSTONE OF PROFESSIONAL DEVELOPMENT

In the years since the 1970s, research on the effectiveness of chiropractic care, particularly the manual methods described as spinal manipulation or adjustment (94% of which is delivered by chiropractors),⁵ has expanded considerably. There are now approximately 100 randomized clinical trials on spinal manipulation. Most of these involve investigations into its effects on back pain, neck pain, and headaches, but a growing number of projects address other areas of chiropractic practice, including extremity (leg and arm) problems and nonmusculoskeletal conditions such as infantile colic and hypertension. In a large majority of these studies, spinal manipulation outperformed comparison therapies or placebo. Significantly, not a single patient in any of these studies experienced a major adverse side-effect.

To strengthen the chiropractic research community, the U.S. Health Resources and Services Administration funded for 12 years (1995-2006) an annual chiropractic Research Agenda Conference (RAC), where

researchers and practitioners met to hear reports on completed studies, propose and implement new research projects, develop strategies for interdisciplinary collaboration, and advance the overall direction of chiropractic research. After the completion of this seed funding from the federal government, the profession has self-funded continued annual RAC meetings in conjunction with the annual meeting of the Association of Chiropractic Colleges.

The resulting upsurge in chiropractic research has been dramatic. As Scott Haldeman, DC, MD, PhD, who presided over the World Health Organization's Bone and Joint Decade 2000-2010 Task Force on Neck Pain and Its Associated Disorders, wrote in 2010, "There was a time, not long ago, when there was little or no evidence to support the practice of manipulation that is the mainstay of chiropractic practice ... There has, however, been a rapid growth in the number of clinical trials that have studied the effectiveness of manipulation, mobilization and massage over the past 20 years and ... there is now little dispute amongst knowledgeable scientists that manipulation is of value in the management of back pain, neck pain and headaches that make up 90% or more of all patients who seek chiropractic care."⁶

Most of the research cited below focuses on the effectiveness of manual adjustment (manipulation) of the spine and other musculoskeletal structures. While this is the chiropractor's primary area of specialty, the care delivered by chiropractors includes much more, reflecting chiropractors' expertise in diagnosis, radiology, rehabilitation, physiotherapy, non-manipulation manual methods (mobilization and massage), nutrition, prevention, and health promotion, along with their widely acknowledged skills in doctor-patient relationships.^{7, 8} In a 1998 *Archives of Internal Medicine* article, Harvard Medical School professors Kaptchuk and Eisenberg described these relationships appreciatively: "Chiropractic's ultimate lesson may be to reinforce the principle that the patient-physician relationship is fundamentally about words and deeds of connection and compassion. Chiropractic has managed to embody this message in the gift of the hands."⁸

Patient satisfaction with chiropractic care is based on many factors, foremost among these the judgment by patients that their therapeutic goals—particularly relief of pain and restoration of function—have been met or exceeded. In 2010, the Secretary of Health and Human Services, Kathleen Sebelius, submitted a report to Congress on the Demonstration of Coverage of Chiropractic Services Under Medicare.⁹ This report noted that, “Sixty percent of respondents indicated that they received “complete” or “a lot” of relief of symptoms from their chiropractic treatments. Satisfaction with care was high, with 87 percent reporting levels of 8 or higher on a 10-point scale and 56 percent indicating a perfect score of 10. Similarly high proportions reported that chiropractors listened carefully and spent sufficient time with them.”

LOW BACK PAIN

For more than half of patients seeking chiropractic care, low back pain is the primary reason. It is, therefore, not surprising that low back pain has been a central focus of chiropractic-related research. More than 80% of people experience low back pain at some time in their lives. For many, the condition becomes chronic. While studies on direct and indirect costs of low back pain vary widely in methodology and bottom line conclusions, and no definitive figures for the United States are available, the overall cost is understood to amount to at least tens of billions of dollars annually and perhaps hundreds of billions.¹⁰

Back pain is the leading cause of work-related disability and missed days of work. Moreover, chronic back pain is associated with reduced mobility, quality of life, and longevity,¹¹ along with increased rates of a variety of other health problems.¹² Conventional medicine has found the treatment of low back pain to be quite challenging and chiropractic has to an appreciable extent filled the resulting niche.

National Low Back Pain Guidelines

The body of scientific studies on spinal manipulation for low back pain is now broad and deep, as recognized by national assessment and guidelines panels in the United States and other nations including Great

Britain,¹³ Sweden,¹⁴ Denmark,¹⁵ and Australia.¹⁶ Basing their conclusions on several dozen randomized clinical trials of spinal manipulation, these expert panels (primarily composed of medical physicians) have correctly noted that manipulation has a verifiably strong record for successfully treating low back pain.

RAND Appropriateness and Utilization Study

The first independent guideline on spinal manipulation for low back pain was the influential RAND Appropriateness and Utilization Study,⁵ which concluded in 1991 that manipulation was “appropriate” for acute low back pain based on ratings by expert panels, which based their evaluations on the existing scientific literature.

Agency for Healthcare Policy and Research Guidelines

The 1994 Guidelines for Acute Lower Back Pain,¹⁷ developed for the Agency for Healthcare Policy and Research (AHCPR) of the U.S. Department of Health and Human Services by a blue-ribbon panel composed primarily of medical physicians and chaired by an orthopedic surgeon (2 of the 23 members were chiropractors), included a powerful endorsement of spinal manipulation.

Based on an extensive literature review and consensus process, the AHCPR Guidelines concluded that spinal manipulation “hastens recovery” from acute low back pain. Among dozens of nonsurgical therapies, the panel judged that only two had substantial scientific support—spinal manipulation and pain medications, such as analgesics and anti-inflammatory drugs. Of the two, the AHCPR Guidelines found that only spinal manipulation offers both “symptomatic relief” and “functional improvement.” Thus, one may reasonably infer that for patients with acute low back pain who show none of the guidelines’ diagnostic “red flags” (fractures, tumors, infections), manipulation is the treatment of choice.

American Pain Society/American College of Physicians

In 2007, *Annals of Internal Medicine* published low back pain guidelines jointly developed by the American Pain Society (APS) and the American College of Physicians (ACP).¹⁸ After thoroughly surveying and analyzing

the available research, the all-medical APS-ACP panel recommended that for patients who do not improve with self-care options, doctors should consider the addition of non-pharmacologic therapy “with proven benefits.” Spinal manipulation was one of four methods recommended for chronic and subacute low back pain (along with cognitive-behavioral therapy, exercise, and interdisciplinary rehabilitation) and was the only one of these also recommended for cases of acute low back pain.

LOW BACK PAIN RESEARCH: KEY STUDIES

Dozens of well-designed research trials involving spinal manipulation for low back pain helped form the basis for the national guidelines just described. Among the most important are the following:

First Study on Chiropractic in a Medical Journal, Co-Authored by Chiropractor and Medical Doctor (Canada, 1985)

A powerful study illustrating the value of chiropractic care for chronic low back pain patients was performed at the University of Saskatchewan hospital orthopedics department by Kirkaldy-Willis, a world-renowned orthopedic surgeon, and Cassidy, a chiropractor who later became the department’s research director. The approximately 300 subjects in this study were “totally disabled” by low back pain, with pain present for an average of 7 years. All had gone through extensive, unsuccessful medical treatment before participating as research subjects.

After 2 to 3 weeks of daily chiropractic adjustments, more than 80% of the patients without stenosis (spinal canal narrowing) had good to excellent results, reporting substantially decreased pain and increased mobility. After chiropractic treatment, more than 70% were improved to the point of having no work restrictions. Follow-up a year later demonstrated that the changes were long-lasting. Even those with a narrowed spinal canal, generally considered the most challenging cases, showed a notable response. More than half of these patients improved, and about one in five were pain free and on the job 7 months after treatment.

First Large Chiropractic Trial Published in British Medical Journal (United Kingdom, 1990)

In the first large randomized clinical trial to demonstrate substantial short-term and long-term benefits from chiropractic care, orthopedic surgeon Meade compared chiropractic care and standard hospital outpatient treatment in a trial with more than 700 patients.^{19, 20} Meade concluded that, “For patients with low-back pain in whom manipulation is not contraindicated, chiropractic almost certainly confers worthwhile, long-term benefit in comparison to hospital outpatient management.” He also stated, “One of the unexpected findings was that the treatment difference—the benefit of chiropractic over hospital treatment—actually persists for the whole of that three-year period [of the study] ... the treatment that the chiropractors give does something that results in a very long-term benefit.”²¹

Chronic Low Back Pain Study (United States, 1995)

In a randomized trial of 209 patients published in *Spine*, Triano and colleagues compared spinal manipulation to education programs for chronic low back pain.²² These researchers found greater improvement in pain and activity tolerance in the chiropractic group, reporting that “immediate benefit from pain relief continued to accrue after manipulation, even for the last encounter at the end of the 2-week treatment interval.” They concluded, “There appears to be clinical value to treatment according to a defined plan using manipulation even in low back pain exceeding 7 weeks duration.”

Spinal Manipulation Outperforms Acupuncture and Medication (Australia, 2003)

In a study of 115 patients with chronic spinal pain, Giles and Muller compared the effects of medication (NSAID or analgesic not previously ineffective for the individual patient), spinal manipulation, and acupuncture.²³ Treating practitioners were told to follow their normal office procedures to determine whether manipulation or acupuncture was appropriate and to determine which adjustive procedures or acupuncture points should be used. The highest proportion of early recovery was found for manipulation (27.3%), followed by acupuncture (9.4%) and medication

(5%). A follow-up study found that “in patients with chronic spinal pain syndromes, spinal manipulation, if not contraindicated, may be the only treatment modality of the assessed regimens that provides broad and significant long-term benefit.”²⁴

Chiropractic Yields Outcomes Superior to Medical Care (United States, 2004)

In a practice-based research study of 2870 patients with acute and chronic low back pain who visited either medical or chiropractic physicians' offices and received customary care, Haas and colleagues found consistent evidence of superior outcomes for those receiving chiropractic care.²⁵ Acute patients demonstrated greater relief at all time points. A clinically important advantage for chiropractic patients was seen in chronic patients in the short-term, and both acute and chronic chiropractic patients experienced somewhat greater relief up to 1 year. The advantage for the chiropractic group was prominent for chronic patients with leg pain below the knee.

First Dose-Response Study on Chiropractic for Chronic Low Back Pain (United States, 2004)

In the first trial to evaluate the effects of different frequency schedules for chiropractic visits in cases of chronic low back pain, a pilot study by Haas and colleagues²⁶ randomly allocated 72 patients to different schedules of visits (1, 2, 3 or 4 visits per week for 3 weeks). At 4 weeks, there was a substantial trend demonstrating superior benefits with a larger number of visits. Relief was greatest for patients receiving care 3 to 4 times per week for 3 weeks.

Chiropractic Superior to Medical Care in British National Health Service Hospital Study (United Kingdom, 2008)

A small but influential study by Wilkey et al²⁷ featured a head-to-head comparison of chiropractic care versus medical care for chronic low back pain in a British National Health Service hospital pain clinic. The chiropractic and pain clinic groups started with similar levels of pain, although the chiropractic group was on average a decade older than the medical group and chiropractic subjects had endured their pain for a mean of

three years longer (7 vs. 4 years). Nevertheless, improvement in pain intensity at week 8 was 1.8 points greater (on a zero to 10 scale) for the chiropractic group than for the pain clinic group, a substantial difference. Most importantly, disability scores demonstrated a much larger benefit from chiropractic care, with a greater than 5-fold difference in the degree of improvement. These data measured effects through the end of the 8-week treatment period. Within a year after the publication of this study, Great Britain's National Health Service changed its guidelines for chronic low back pain to include coverage for spinal manipulation.

Two Chiropractic Techniques Outperform Conventional Medicine for Low Back Pain in Older Adults (United States, 2009)

In the first randomized controlled trial of chiropractic care for older adults, and one of the first to compare different methods of chiropractic adjustment to each other and to conservative medical care, Hondras et al evaluated the effects of these three approaches for 240 people with subacute and chronic low back pain.²⁸ High-velocity and low-velocity chiropractic techniques (combined with standardized exercise recommendations) resulted in similar levels of improvement, with both chiropractic methods substantially outperforming the medical care group, who received the same exercise instructions along with pain medication.

NECK PAIN

Neck pain is the second most common reason patients seek chiropractic care. While chiropractic care can be helpful to individuals with acute or chronic neck pain, at this time the research supporting spinal manipulation for chronic neck pain is stronger and more extensive than for acute cases. To put this into context, it should be understood that chiropractic is not unique in this respect; no other treatments for acute neck pain have strong research support.

RAND Appropriateness Study for Chronic Neck Pain (1995)

The RAND Corporation conducted both a literature review and a multidisciplinary panel appropriateness study for neck pain.²⁹ This RAND

report stated that spinal manipulation could deliver short-term pain relief and improved range of motion for subacute or chronic neck pain, while concluding that research on acute neck pain was too limited to reach any conclusion.

World Health Organization Bone and Joint Decade Report (2008)

By far the most comprehensive recent evaluation of all neck pain therapies was performed by the Bone and Joint Decade 2000–2010 Task Force on Neck Pain and Its Associated Disorders.³⁰ In the panel's report on noninvasive interventions, it concluded that, "Our best evidence synthesis suggests that therapies involving manual therapy and exercise are more effective than alternative strategies for patients with neck pain; this was also true of therapies which include educational interventions addressing self-efficacy." Because chiropractors consistently include exercise advice and share relevant self-care educational materials with patients as part of overall care,³¹ chiropractic management of neck pain substantially embodies the full range of noninvasive therapeutic approaches recommended by the Bone and Joint Decade Task Force.

NECK PAIN RESEARCH: KEY STUDIES

Manual Therapy Superior to Comparison Treatments and Placebo (Netherlands, 1993)

A team of Dutch researchers led by Koes³² studied patients with persistent back and neck complaints. In a randomized trial, they were treated with either manual therapy (spinal manipulation and mobilization), physiotherapy (exercises, massage, electrotherapy, ultrasound, shortwave diathermy), treatment by the general practitioner (analgesics, posture advice, home exercise and bedrest), or a placebo treatment consisting of detuned shortwave diathermy and detuned ultrasound. For neck and back complaints together, improvements in severity of the main complaint were larger with manipulative therapy than physiotherapy; for neck complaints only, the mean improvement in the main complaint as shown by the visual analog scale was slightly better for manipulative rather than physical therapy. Both manual therapy and physiotherapy (both of which are part

of the chiropractor's scope of practice) were superior to medical care and placebo. In this study, the placebo yielded results superior to medical care.

Chiropractic Manual Methods Plus Exercise Helpful for Chronic Neck Pain (Sweden, 2006)

In a randomized clinical trial, Palmgren et al found that a group of chronic neck pain patients who received 15-25 chiropractic treatments over a 5-week period had significantly lower pain scores and greater head repositioning accuracy than another group with the same condition given a similar examination but no treatment.³³ Chiropractic care included high- and low-velocity techniques, myofascial release, and spine-stabilizing exercises. The researchers concluded that chiropractic care could be effective in reducing pain originating in the cervical spine—as well as enhancing proprioceptive sensibility (movement and position sense).

HEADACHES

A series of studies have shown chiropractic to be an effective treatment for headaches. Because headaches can develop from a variety of causes, alone or in combination, a holistic approach that considers all possible causes is desirable. Such causes may include spinal joint dysfunction (subluxation), muscular imbalance and tension, negative reactions to foods or medications, sleep disturbances, emotional stress, or chemical irritants in the water or air.

Duke University Headache Report, Cochrane Review

In 2001, the Duke University Center for Health Policy Research and Education completed *Evidence Report: Behavioral and Physical Treatments for Tension-type and Cervicogenic Headache*,³⁴ based on a comprehensive review of all available headache research. Among its conclusions were that (1) in comparison to the use of the medication amitriptyline, chiropractic produces slightly less improvement during the treatment period, but markedly superior long-term results in the treatment of tension-type headache and (2) compared to various soft tissue procedures, a course of manipulation treatments produces sustained improvement in headache frequency and severity in the treatment of

cervicogenic headache (pain originating in the neck and referred to the head). A 2004 systematic review of headache research for the Cochrane Collaboration, *Noninvasive Physical Treatments for Chronic/Recurrent Headaches*,³⁵ reached conclusions similar to the Duke report.

HEADACHE RESEARCH: KEY STUDIES

After Treatment Stops, Effects Last Far Longer from Chiropractic than Medication (United States, 1995)

In a randomized clinical trial that was later recognized by a Scandinavian rheumatology journal³⁶ as an extremely high quality study, Boline and colleagues found that one month of chiropractic care (approximately 2 visits per week) was more effective than the medication amitriptyline for long-term relief of headache pain.³⁷ During the treatment phase of the trial, pain relief among those treated with medication was roughly comparable to the chiropractic group. But chiropractic patients maintained their levels of improvement after treatment was discontinued, while those taking medication returned to pretreatment status in an average of 4 weeks after its discontinuation. This strongly implies that while medication suppressed the symptoms, chiropractic addressed the problem at a deeper, more causal level.

Cervicogenic Headaches Respond to Spinal Manipulation (Denmark, 1997)

A randomized clinical trial by Nilsson et al³⁸ evaluated the effectiveness of spinal manipulation for cervicogenic headache. Researchers compared groups given either high-velocity cervical spinal manipulation or low-level laser treatment and found statistically significant improvement for the chiropractic group in terms of decreased pain, headache hours per day and use of pain medication.

Chiropractic Helpful for Migraines (United States, 1998)

A randomized trial by Nelson and colleagues³⁹ in which chiropractic adjustments were compared to amitriptyline, demonstrated that migraine headaches were responsive to chiropractic care and that adding amitriptyline to chiropractic treatment conferred no additional benefit.

Study Confirms Chiropractic's Value for Migraines (Australia, 2000)

In a randomized controlled trial lasting 6 months, Tuchin et al⁴⁰ compared manipulation to detuned ultrasound. Two months of chiropractic adjustments (maximum of 16 treatments) yielded statistically significant improvement in migraine frequency, duration, disability and medication use.

Dose-Response Study Indicates Need for Adequate Number of Visits (United States, 2004)

Seeking to determine the proper frequency of chiropractic treatments for headache patients, Haas and colleagues randomly allocated 24 adults with cervicogenic headache into groups visiting a chiropractor 1, 3, or 4 times per week over a 3-week period.⁴¹ All patients received high-velocity, low-amplitude manipulations plus up to two physical modalities including heat and soft tissue therapy. Greater pain relief was seen at 4 and 12 weeks for the patients receiving 9 and 12 treatments than for those receiving 3, demonstrating that continuing treatments for up to 9-12 treatments conferred additional benefits.

EXTREMITY CONDITIONS

Chiropractors' focus on the spine is enhanced through attention to the role of the extremities (arms and legs). Since the earliest days of the profession, doctors of chiropractic have adjusted extremity joints. In some cases, this is to address local problems at, for example, the ankle, knee, or shoulder. In other cases, the goal is to influence the overall balance of the body, including the spine. Causation runs in both directions—spinal adjustments can influence the extremities, and extremity manipulation can influence the spine.

Two comprehensive reviews have evaluated the status of extremity manipulation research, which is currently much less extensive than research on manipulation of the spine.

Council on Chiropractic Guidelines and Practice Parameters (2009)

Brantingham and colleagues,⁴² an expert panel appointed by the Scientific Commission of the Council on Chiropractic Guidelines and Practice Parameters (www.ccgpp.org), reviewed all available research on lower extremity conditions and found fair evidence for manipulative therapy of the knee and/or full kinetic chain, and of the ankle and/or foot, combined with multimodal or exercise therapy for knee osteoarthritis, patellofemoral pain syndrome, and ankle inversion sprain. They found limited evidence for manipulative therapy of the ankle and/or foot combined with multimodal or exercise therapy for foot conditions such as plantar fasciitis, metatarsalgia, and hallux limitus/rigidus.

United Kingdom Evidence Report (2010)

Bronfort et al, in their comprehensive 2010 UK Evidence Report,⁴³ included a review of research on manual therapies for upper and lower extremity problems. For lower extremity conditions, they reached conclusions quite similar to the Brantingham review. For upper extremity conditions (which were not included in the Brantingham review), Bronfort's group found moderate evidence supporting the addition of manipulation or joint mobilization to usual medical care for shoulder girdle pain; inconclusive evidence in a favorable direction on manipulation/mobilization for rotator cuff pain; moderate evidence that long-term benefits from elbow mobilization with exercise exceed those from corticosteroid injections; and inconclusive evidence in a favorable direction for manipulation and mobilization in the treatment of carpal tunnel syndrome.

Key research trials that helped form the basis for these reviews and guidelines include the following:

SHOULDER

Three Studies: Manipulation Helpful for Certain Cases of Shoulder Pain

In a 1997 study from the Netherlands published in *British Medical Journal*, Winters and colleagues found that for "shoulder girdle" pain, manipulation

was superior to physical therapy, while for “synovial” pain at the shoulder’s ball-and-socket joint, corticosteroid injections were the most effective approach.⁴⁴ Another Dutch study, published in 2004 in *Annals of Internal Medicine* by Bergman et al,⁴⁵ found that adding manipulative therapy to usual medical care yielded superior outcomes in patients with shoulder dysfunction and pain. And in a 2007 study from the United States published in *Journal of the American Chiropractic Association*, Munday and colleagues conducted a randomized, single-blinded, placebo-controlled clinical trial⁴⁶ on shoulder impingement syndrome, in which one group received shoulder adjustments and the other a placebo (detuned ultrasound). Participants were treated 8 times over 3 weeks, resulting in a significant pain reduction for the group receiving chiropractic care.

HIP

Hip Manipulation Effective for Hip Osteoarthritis (United States, 2004)

The one major study on hip manipulation was conducted by Hoeksma and colleagues,⁴⁷ who compared hip manipulation and mobilization to an exercise program. Patients were treated once a week for 9 weeks. Success rates (perceived improvement) after 5 weeks were 81% in the manual therapy group and 50% in the exercise group. Patients in the manual therapy group had significantly better outcomes on pain, stiffness, hip function, and range of motion. Effects of manual therapy on the improvement of pain, hip function, and range of motion endured after 29 weeks.

KNEE

Two Studies Indicate Manual Therapy Effectiveness for Knee Osteoarthritis (United States, 2000 and 2005)

At a military medical center in Texas, Deyle and colleagues⁴⁸ compared a program of manual therapy (applied to the knee as well as to the lumbar spine, hip, and ankle as required), plus standardized knee exercises to a placebo involving sub-therapeutic ultrasound applied to the knee. Clinically and statistically significant improvements in 6-minute walk distance and WOMAC score (for osteoarthritis symptoms) at 4 weeks and

8 weeks were seen in the treatment group but not the placebo group. By 8 weeks, average 6-minute walk distances had improved by 13.1% and WOMAC scores had improved by 55.8%. At 1 year, patients in the treatment group had clinically and statistically significant gains over baseline WOMAC scores and walking distance; 20% of patients in the placebo group and 5% of patients in the treatment group had undergone knee surgery. The researchers concluded that “a combination of manual physical therapy and supervised exercise yields functional benefits for patients with osteoarthritis of the knee and may delay or prevent the need for surgical intervention.”

Deyle et al’s large study on knee osteoarthritis⁴⁹ compared a home-based physical therapy regime with a clinic-based program that included both supervised exercise and manual therapy. These investigators concluded that a home exercise program was effective for patients with osteoarthritis of the knee and that clinical visits with manual therapy and supervised exercise increased the benefit.

ANKLE

Manipulation Superior to Placebo for Ankle Sprain (Union of South Africa, 2001)

Pellow and Brantingham performed the first chiropractic trial on ankle inversion sprains,⁵⁰ comparing results of an ankle mortise separation adjustment to a placebo intervention of detuned ultrasound. Patients received 8 treatment sessions over 4 weeks. The researchers found that “although both groups showed improvement, statistically significant differences in favor of the adjustment group were noted with respect to reduction in pain, increased ankle range of motion, and ankle function.”

For Ankle Sprains, RICE Plus Mobilization Superior to RICE Alone (United States, 2001)

Standard treatment for ankle sprains is based on the RICE (rest, ice, compression and elevation) protocol. Green et al found that adding mobilization to RICE was more effective than RICE alone for decreasing pain and increasing ankle mobility.⁵¹ Patients were treated every second day

for 2 weeks or until discharge criteria were met. The experimental group had greater improvement in range of movement before and after each of the first 3 treatment sessions. The experimental group also had greater increases in stride speed during the first and third treatment sessions.

ATHLETIC INJURY PREVENTION

Chiropractic Care Brings Major Decrease in Leg Injuries (Australia, 2010)

In a groundbreaking 2010 study,⁵² chiropractic researchers Hoskins and Pollard demonstrated that adding chiropractic care to standard medical and physical therapy approaches significantly decreased the number of leg injuries and missed games among Australian professional football players.

NONMUSCULOSKELETAL DISORDERS

Since chiropractic's earliest days, there have been numerous reports of individual cases where nonmusculoskeletal conditions appear to have responded positively to chiropractic care, in some cases dramatically. These types of responses, while numerous, have been sporadic and largely unpredictable. In addition to case reports and case series in the scientific literature, there have also been a small number of randomized controlled trials showing notable benefits from spinal adjustments for certain visceral disorders. Among these conditions are infantile colic, hypertension and cervicogenic vertigo (dizziness originating in the neck). Further research is needed before conclusions can be reached about the effectiveness of spinal manipulation for these and other visceral disorders.

Review of Chiropractic Care for Nonmusculoskeletal Problems

Hawk and colleagues evaluated research on chiropractic care for nonmusculoskeletal disorders in a 2007 review published in *The Journal of Alternative and Complementary Medicine*.⁵³ Using methods that incorporated the effects of the full clinical encounter rather than spinal manipulation alone, they found a somewhat wider range of nonmusculoskeletal conditions helped by chiropractors, including asthma, cervicogenic

vertigo, and infantile colic, while categorizing as “promising for potential benefit” the application of manual procedures for children with otitis media and elderly patients with pneumonia.

INFANTILE COLIC

Chiropractic Adjustments Far Superior to Standard Medication (Denmark, 1999)

Infantile colic, which occurs in approximately one-fifth of newborns, involves prolonged, intense, high-pitched crying and is believed to be of gastrointestinal origin. In a Danish study at the University of Odense, Wiberg and colleagues performed a randomized clinical trial⁵⁴ in which colicky babies were given either very gentle spinal manipulation or dime-thicone, an anti-foaming agent used in medical treatment of colic. Subjects were recruited by health visitor nurses from Denmark’s National Health Service, which integrates chiropractic care. Treatment lasted 2 weeks. By day 12, hours of crying decreased by 66% for the chiropractic group and 38% for the medication group.

HYPERTENSION

Upper Cervical Chiropractic Method Helpful for Hypertension (United States, 2007)

In a recent example of medical-chiropractic collaboration, Dickholtz, a chiropractor, and Bakris, a medical hypertension specialist, published a study in which upper cervical (neck) chiropractic adjustments led to sustained improvement in chronic hypertension patients, “similar to that seen by giving two different anti-hypertensive agents simultaneously,” with 88% of subjects in the treatment group experiencing an 8mm Hg drop in diastolic blood pressure.⁵⁵ All subjects were taken off their hypertension medications prior to the study and 85% of the patients in the chiropractic treatment group required only one adjustment to yield these benefits through the full 8 weeks of the study. Other studies on chiropractic care for hypertension have yielded far less satisfactory results⁵⁶ and efforts are currently underway to determine whether positive findings of the Bakris-Dickholtz study can be replicated.

VERTIGO

Indications That Neck-Related Vertigo Responds to Manual Methods (Australia, 2005)

In a review of 9 studies on possible benefits of manual therapy for patients with cervicogenic vertigo,⁵⁷ Reid et al assessed the validity and findings of the studies, expressed dissatisfaction with their quality, but noted that “a consistent finding was that all studies had a positive result with significant improvement in symptoms and signs of dizziness after manual therapy treatment.”

COMPARATIVE SAFETY OF CHIROPRACTIC

Chiropractic has an excellent safety record but no healthcare method is completely free of risk. If spinal manipulation were a prescription medication, its rate of major adverse effects would justify calling it remarkably safe. The area of greatest controversy is vertebrobasilar accident (VBA), or stroke. Chiropractic students are taught best practices for recognizing impending strokes, appropriate care and caution are given strong emphasis, and the profession endorses the use of informed consent.

Full understanding of this issue hinges on the question of whether the rare stroke that occurs following a visit to a chiropractor was actually caused by chiropractic treatment or occurred for reasons not associated with it. Only recently has large-scale, rigorous research addressed this issue, with two large reviews of all records in the Canadian province of Ontario. Because Canada has publicly-funded universal healthcare, this data is presumed to be comprehensive. Questions of a possible causative role for spinal manipulation raised in the first study, by Rothwell et al⁵⁸ appear to have been fully resolved in the later Cassidy et al study.⁵⁹

Rothwell Study (Canada, 2001)

Rothwell et al⁵⁸ reviewed all records from 1993-1998 and found a total of 582 vertebrobasilar accident cases in the province. Each was age and gender matched to 4 controls from the Ontario population with no history of stroke at the event date. Public health insurance billing records were

used to document utilization of chiropractic services during the year prior to VBA onset. Slightly more than 90% had no chiropractic visits in the year preceding their VBA. Of the 57 individuals with VBAs who did visit a chiropractor in the 365 days preceding the VBA (out of 50 million chiropractic visits during the 5-year period studied), 27 are believed to have had cervical manipulation. Of these, 4 individuals visited a chiropractor on the day immediately preceding the VBA, 5 in the previous 2-7 days, 3 in the previous 8-30 days, and 15 in the previous 31-365 days.

Compared to the controls, there was an increased association of VBA among patients who saw a chiropractor 1-8 days prior to the VBA event, but a decreased association of CVA among patients who saw a chiropractor 8-30 days before the event. Rothwell et al found no association between recent chiropractic visits and VBAs in patients over age 45. However, patients under age 45 were 5 times more likely to have visited a chiropractor within the week prior to the VBA and 5 times more likely to have had 3 or more visits with a cervical diagnosis in the month preceding the VBA. Though Rothwell and colleagues explicitly cautioned against using their data to infer a cause-and-effect relationship between spinal manipulation and stroke, some used their data to make such a connection. There were a total of 6 strokes within 7 days of neck manipulation in the under-45 group, out of approximately 15 million total neck manipulations during the time period evaluated.

Cassidy Study (Canada, 2008)

Several years after the Rothwell study, Cassidy and colleagues⁵⁹ completed a review of the same Ontario records evaluated by Rothwell's group and extended the time period covered in the review by three years. They performed additional analyses to determine whether patients who had seen a chiropractor were more likely to have had a stroke than patients who had seen a medical physician. This question, which had not been part of the earlier Rothwell review, was crucial because patients in the early stages of a stroke commonly experience symptoms (headache, neck pain) that may lead them to consult either a chiropractor or a medical doctor.

Cassidy's group found that it was no more likely for a stroke patient to have seen a chiropractor than a medical physician. In fact, those visiting a medical doctor rather than a chiropractor were more likely to have had a stroke, although this difference was not statistically significant. The authors concluded, "The increased risks of VBA stroke associated with chiropractic and PCP [primary care physician] visits is likely due to patients with headache and neck pain from VBA dissection seeking care before their stroke. We found no evidence of excess risk of VB stroke associated chiropractic care compared to primary care."

COST-EFFECTIVENESS

While the primary consideration for any form of treatment is clinical effectiveness (improvement in the patient's condition), cost-conscious patients, insurers, and policy makers also look closely at cost-effectiveness in evaluating healthcare options. Chiropractic fares quite well in such comparisons.

Mercer Report: Chiropractic Is the Most Cost-Effective Approach for Low Back and Neck Pain (United States, 2009)

Nitesh Choudhry, MD, PhD, of Harvard Medical School, and Arnold Milstein, MD, Chief Physician at Mercer Health and Benefits and Medical Director of the Pacific Business Group on Health, co-authored the 2009 report, *Do Chiropractic Physician Services For Treatment of Low-Back and Neck Pain Improve the Value of Health Benefit Plans? An Evidence-Based Assessment of Incremental Impact on Population Health and Total Healthcare Spending*.⁶⁰ This report combined a rigorous analysis of direct and indirect costs with equally relevant (though often missing from such analyses) evidence concerning clinical effectiveness. In other words, Choudhry and Milstein started with the assumption that low cost is only a virtue if a product or service effectively delivers what it promises. Including both clinical effectiveness and cost in their analysis, they concluded that chiropractic care was far more valuable than medical treatment for neck and low back pain.

These analysts found that for that for neck pain, chiropractic physician care decreases annual spending by \$302 compared to medical physician care, and that for low back pain, chiropractic increases total annual per patient spending by \$75 compared to medical physician care. Their analysis also noted that chiropractic care, particularly when combined with exercise, is significantly more effective than medical care for patients for low back and neck pain. This combination of factors led them to conclude that, “when considering effectiveness and cost together, chiropractic physician care for low back and neck pain is *highly cost effective*, represents a good value in comparison to medical physician care and to widely accepted cost-effectiveness thresholds. Because we were unable to incorporate savings in drug spending commonly associated with US chiropractic care, our estimate of its comparative cost-effectiveness is likely to be understated.”

Chiropractors in Primary Care Role Help Cut Costs (United States, 2004, 2007)

A collaborative 7-year research project led by Sarnat, a medical physician, and Winterstein, a chiropractic physician, documented that patients in an integrative independent practice association—whose primary care physicians (PCPs) were doctors of chiropractic and CAM-oriented medical doctors with a primarily nonsurgical and nonpharmaceutical orientation—were able to achieve substantial cost savings in comparison to patients whose PCPs (in the same health maintenance organization in the same time frame) used conventional medicine alone. Clinical and costs utilization based on 70,274 member-months over a 7-year period demonstrated decreases of 60.2% for in-hospital admissions, 59.0% for hospital days, 62.0% for outpatient surgeries and procedures, and 85% for pharmaceutical costs.^{61, 62}

Manga Reports: Chiropractic Far More Cost-Effective than Medical Care for Low Back Pain (Canada, 1993, 1998)

Twice in the 1990s, University of Ottawa health economist Pran Manga was commissioned by the government of Ontario to assess the effectiveness and cost-effectiveness of chiropractic management of low-back pain.^{63, 64} His assessment of the comparative cost data in his first report led

him to conclude that, “There is an overwhelming body of evidence indicating that chiropractic management of low-back pain is more cost-effective than medical management. We reviewed numerous studies that range from very persuasive to convincing in support of this conclusion. The lack of any convincing argument or evidence to the contrary must be noted and is significant to us in forming our conclusions and recommendations.” The cost advantages for chiropractic for matched conditions were so impressive that Manga, in his second report, concluded that doubling the utilization of chiropractic services from 10% to 20% could result in savings of as much as \$770 million annually in direct costs and \$3.8 billion in indirect costs.

RECENT CHIROPRACTIC ADVANCES: INTEGRATION AND INCLUSION

MILITARY

Among the most promising developments in the mainstreaming of chiropractic is the recent inclusion of chiropractic in the healthcare systems serving veterans and active-duty military personnel. Starting with successful pilot programs in the 1990s, both the Veterans Administration (VA) and Department of Defense now include chiropractic services as an integral part of the healthcare available to veterans and active duty members of the military. As of 2010, chiropractors were serving in official capacities at approximately 36 VA hospitals and 60 military treatment facilities in the U.S and overseas.

Retired General Becky Halstead, the first female graduate of West Point to be promoted to Brigadier General and the first woman to command in combat at the strategic level, is among chiropractic’s most enthusiastic advocates. Gen. Halstead puts it this way: “The year I was deployed to Iraq I missed my friends and family—and my chiropractor! The hands-on active care of doctors of chiropractic and their advice on a healthy lifestyle are essential to our military men and women.”

SPORTS

Chiropractors are now an integral part of the sports medicine staffs for the Olympic Games and teams in the National Football League, National Basketball Association and Major League Baseball, as well as collegiate, scholastic and youth club sports. Doctors of chiropractic are well trained to address the needs of athletes from a wide variety of individual and team sports. The chiropractor's knowledge of neuromusculoskeletal disorders makes chiropractic care a perfect fit for the prevention and treatment of most sport-related injuries.

Reflecting this expertise, 2010 marked the first time that chiropractors occupied the two top leadership positions for the U.S. Olympic Committee (USOC) medical team—with Michael Reed, DC, serving as USOC Medical Director, and Bill Moreau, DC, as USOC Director of Sports Medicine Clinics.

BUSINESS AND INDUSTRY

The musculoskeletal ailments effectively treated by chiropractors (back pain, neck pain, headaches and extremity problems) are the leading cause of work-related disability and missed days of work, which adversely impacts both workers' well-being and the corporate bottom line. As a result, many small and large employers seek out chiropractors as consultants and, in some cases, as full-time medical staff members. Aside from treating injured workers and those with other painful conditions, chiropractors' expertise in workplace ergonomics and wellness counseling provides an essential service for corporations desiring to keep their employees healthy.

PREVENTION AND HEALTH PROMOTION

In keeping with their holistic approach to healthcare, chiropractors encourage patients to take an active role in restoring and maintaining health, with particular emphasis on doctor-guided self-care through exercise and nutrition.⁶⁵ The American Public Health Association

includes a Chiropractic Healthcare Section that focuses on public health issues such as wellness, health promotion and disease prevention in the context of chiropractic policies and practices. In addition, the Council on Chiropractic Education now mandates that all students graduating from chiropractic colleges demonstrate knowledge of evidence-based prevention and mastery of methods for applying these approaches with patients.

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REFERENCES

1. Chapman-Smith DA. *The Chiropractic Profession*. Des Moines: NCMIC Group; 2000.
2. *WHO Guidelines on Basic Training and Safety in Chiropractic*. Geneva: World Health Organization; 2005.
3. Redwood D, Hawk C, Cambron J, Vinjamury SP, Bedard J. Do chiropractors identify with complementary and alternative medicine? Results of a survey. *J Altern Complement Med*. May 2008;14(4):361-368.
4. *Clinicians' and Educators' Desk Reference on the Licensed Complementary and Alternative Healthcare Professions*. Seattle: Academic Consortium for Complementary and Alternative Healthcare; 2009.
5. Shekelle PG, Adams AH, et al. *The appropriateness of spinal manipulation for low-back pain: project overview and literature review*. R-4025/1-CCR/FCER. Santa Monica: RAND; 1991.
6. Haldeman S, Underwood M. Commentary on the United Kingdom evidence report about the effectiveness of manual therapies. *Chiropr Osteopat*. Feb 25 2010;18(1):4.
7. Cherkin DC, MacCornack FA. Patient evaluations of low back pain care from family physicians and chiropractors. *West J Med*. 1989;150(3):351-355.
8. Kaptchuk TJ, Eisenberg DM. Chiropractic: origins, controversies, and contributions. *Arch Intern Med*. 1998;158(20):2215-2224.

-
-
9. Stason WB, Ritter D, Shepard DS, et al. Report to Congress on the Evaluation of the Demonstration of Coverage for Chiropractic Services Under Medicare. Baltimore: Centers for Medicare and Medicaid Services; 2009.
 10. Dagenais S, Caro J, Haldeman S. A systematic review of low back pain cost of illness studies in the United States and internationally. *Spine J.* 2008;8:8-20.
 11. Zhu K, Devine A, Dick IM, Prince RL. Association of back pain frequency with mortality, coronary heart events, mobility, and quality of life in elderly women. *Spine.* Aug 15 2007;32(18):2012-2018.
 12. Fanuele JC, Birkmeyer NJ, Abdu WA, Tosteson TD, Weinstein JN. The impact of spinal problems on the health status of patients: have we underestimated the effect? *Spine.* Jun 15 2000;25(12):1509-1514.
 13. Rosen M. *Back pain: report of a clinical standards advisory group committee on back pain.* London: HMSO; 1994.
 14. Commission on Alternative Medicine, 12: 13-16. *Social Departementete: Legitimization for vissa kiropraktorer.* Stockholm; 1987.
 15. Danish Institute for Health Technology Assessment. *Low-back pain, frequency, management, and prevention from an HTA perspective* 1999.
 16. Thompson CJ. *Second report, Medicare benefits review committee.* Canberra: Commonwealth Government Printer; 1986.
 17. Bigos S, Bowyer O, Braen G. *Acute Lower Back Pain in Adults. Clinical Practice Guideline, Quick Reference Guide Number 14.* AHCPR Pub. No, 95-0643. Rockville: U.S. Department of Health and Human Services, Public Health Service, Agency for Healthcare Policy and Research; 1994.
 18. Chou R, Huffman LH. Nonpharmacologic therapies for acute and chronic low back pain: a review of the evidence for an American Pain Society/American College of Physicians clinical practice guideline. *Ann Intern Med.* Oct 2 2007;147(7):492-504.
 19. Meade TW, Dyer S, Browne W, Townsend J, Frank AO. Low back pain of mechanical origin: randomised comparison of chiropractic and hospital outpatient treatment. *BMJ.* 1990;300(6737):1431-1437.
 20. Meade TW, Dyer S, Browne W, Frank AO. Randomised comparison of chiropractic and hospital outpatient management for low back pain: results from extended follow up. *BMJ.* 1995;311(7001):349-351.
 21. Meade TW. Interview on Canadian Broadcasting Corporation. *Chiropractic: A Review of Current Research.* Arlington, Virginia: Foundation for Chiropractic Education and Research; 1992.

-
-
22. Triano JJ, McGregor M, Hondras MA, Brennan PC. Manipulative therapy versus education programs in chronic low back pain. *Spine*. 1995;20:948-955.
 23. Giles LG, Muller R. Chronic spinal pain: a randomized clinical trial comparing medication, acupuncture, and spinal manipulation. *Spine*. Jul 15 2003;28(14):1490-1502.
 24. Muller R, Giles LG. Long-term follow-up of a randomized clinical trial assessing the efficacy of medication, acupuncture, and spinal manipulation for chronic mechanical spinal pain syndromes. *J Manipulative Physiol Ther*. Jan 2005;28(1):3-11.
 25. Haas M, Goldberg B, Aickin M, Ganger B, Attwood M. A practice-based study of patients with acute and chronic low back pain attending primary care and chiropractic physicians: two-week to 48-month follow-up. *J Manipulative Physiol Ther*. Mar-Apr 2004;27(3):160-169.
 26. Haas M, Group E, Kraemer DF. Dose-response for chiropractic care of chronic low back pain. *Spine J*. Sep-Oct 2004;4(5):574-583.
 27. Wilkey A, Gregory M, Byfield D, McCarthy PW. A comparison between chiropractic management and pain clinic management for chronic low-back pain in a national health service outpatient clinic. *J Altern Complement Med*. Jun 2008;14(5):465-473.
 28. 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*. Jun 2009;32(5):330-343.
 29. Coulter I, Hurwitz EL, Adams A, et al. *The appropriateness of spinal manipulation and mobilization of the cervical spine: Literature review, indications and ratings by a multidisciplinary expert panel*. Monograph No. DRU-982-1-CCR. Santa Monica, CA: RAND; 1995.
 30. Hurwitz EL, Carragee EJ, van der Velde G, et al. Treatment of neck pain: noninvasive interventions: results of the Bone and Joint Decade 2000-2010 Task Force on Neck Pain and Its Associated Disorders. *Spine*. Feb 15 2008;33(4 Suppl):S123-152.
 31. Jamison JR. Health information and promotion in chiropractic clinics *J Manipulative Physiol Ther*. 2002;25:240-245.
 32. Koes BW, Bouter LM, van Mameren H, et al. A randomized clinical trial of manual therapy and physiotherapy for persistent back and neck

-
-
- complaints: subgroup analysis and relationship between outcome measures. *J Manipulative Physiol Ther.* 1993;16(4):211-219.
33. Palmgren PJ, Sandstrom PJ, Lundqvist FJ, Heikkila H. Improvement after chiropractic care in cervicocephalic kinesthetic sensibility and subjective pain intensity in patients with nontraumatic chronic neck pain. *J Manipulative Physiol Ther.* Feb 2006;29(2):100-106.
34. McCrory DC. *Evidence report: Behavior and physical treatments for tension-type and cervicogenic headaches.* Des Moines, IA: Foundation for Chiropractic Education and Research; 2001.
35. Bronfort G, Nilsson N, Haas M, et al. Non-invasive physical treatments for chronic/recurrent headache. *Cochrane Database Syst Rev.* 2004(3):CD001878.
36. Kjellman GV, Skagren EI, Oberg BE. A critical analysis of randomised clinical trials on neck pain and treatment efficacy: A review of the literature. *Scandinavian Journal of Rehabilitative Medicine.* 1999;31:139-152.
37. Boline PD, Kassak K, Bronfort G, Nelson C, Anderson AV. Spinal manipulation vs. amitriptyline for the treatment of chronic tension-type headaches: a randomized clinical trial. *J Manipulative Physiol Ther.* Mar-Apr 1995;18(3):148-154.
38. Nilsson N, Christensen HW, Hartvigsen J. The effect of spinal manipulation in the treatment of cervicogenic headache. *J Manipulative Physiol Ther.* 1997;20(5):326-330.
39. Nelson CF, Bronfort G, Evans R, Boline P, Goldsmith C, Anderson AV. The efficacy of spinal manipulation, amitriptyline and the combination of both therapies for the prophylaxis of migraine headache. *J Manipulative Physiol Ther.* 1998;21(8):511-519.
40. Tuchin PJ, Pollard H, Bonello R. A randomized controlled trial of chiropractic spinal manipulative therapy for migraine. *J Manipulative Physiol Ther.* 2000;23(2):91-95.
41. Haas M, Group E, Aickin M, et al. Dose-response for chiropractic care of chronic cervicogenic headache and associated neck pain: A randomized pilot study. *J Manipulative Physiol Ther.* 2004;27(9):547-553.
42. Brantingham JW, Globe G, Pollard H, Hicks M, Korporaal C, Hoskins W. Manipulative therapy for lower extremity conditions: expansion of literature review. *J Manipulative Physiol Ther.* Jan 2009;32(1):53-71.
43. Bronfort G, Haas M, Evans R, Leiniger B, Triano J. Effectiveness of manual

-
-
- therapies: the UK evidence report. *Chiropr Osteopat*. Feb 25 2010;18(1):3.
44. Winters JC, Sobel JS, Groenier KH, Arendzen HJ, Meyboom-deJong B. Comparison of physiotherapy, manipulation, and corticosteroid injection for treating shoulder complaints in general practice: randomised, single blind study. *BMJ*. 1997;314(7090):1320-1325.
45. Bergman GJ, Winters JC, Groenier KH, et al. Manipulative therapy in addition to usual medical care for patients with shoulder dysfunction and pain: a randomized, controlled trial. *Ann Intern Med*. Sep 21 2004;141(6):432-439.
46. Munday S, Jones A, Brantingham J, Globe G, Jensen M, Price J. A Randomized, Single-Blinded, Placebo-Controlled Clinical Trial to Evaluate the Efficacy of Chiropractic Shoulder Girdle Adjustment in the Treatment of Shoulder Impingement Syndrome. *J Amer Chiropr Assoc*. 2007;44(6):6-15.
47. Hoeksma HL, Dekker J, Ronday HK, et al. Comparison of manual therapy and exercise therapy in osteoarthritis of the hip: a randomized clinical trial. *Arthritis Rheum*. Oct 15 2004;51(5):722-729.
48. Deyle GD, Henderson NE, Matekel RL, Ryder MG, Garber MB, Allison SC. Effectiveness of manual physical therapy and exercise in osteoarthritis of the knee. A randomized, controlled trial. *Ann Intern Med*. Feb 1 2000;132(3):173-181.
49. Deyle GD, Allison SC, Matekel RL, et al. Physical therapy treatment effectiveness for osteoarthritis of the knee: a randomized comparison of supervised clinical exercise and manual therapy procedures versus a home exercise program. *Phys Ther*. Dec 2005;85(12):1301-1317.
50. Pellow JE, Brantingham JW. The efficacy of adjusting the ankle in the treatment of subacute and chronic grade I and grade II ankle inversion sprains. *J Manipulative Physiol Ther*. Jan 2001;24(1):17-24.
51. Green T, Refshauge K, Crosbie J, Adams R. A randomized controlled trial of a passive accessory joint mobilization on acute ankle inversion sprains. *Phys Ther*. Apr 2001;81(4):984-994.
52. Hoskins W, Pollard H. The effect of a sports chiropractic manual therapy intervention on the prevention of back pain, hamstring and lower limb injuries in semi-elite Australian Rules footballers: a randomized controlled trial. *BMC Musculoskelet Disord*. 2010;11:64.
53. Hawk C, Khorsan R, Lisi AJ, Ferrance RJ, Evans MW. Chiropractic care for nonmusculoskeletal conditions: a systematic review with implications for whole systems research. *J Altern Complement Med*. Jun 2007;13(5):491-512.

-
-
54. Wiberg JM, Nordsteen J, Nilsson N. The short-term effect of spinal manipulation in the treatment of infantile colic: a randomized controlled clinical trial with a blinded observer. *J Manipulative Physiol Ther.* 1999;22(8):517-522.
 55. Bakris G, Dickholtz M, Sr., Meyer PM, et al. Atlas vertebra realignment and achievement of arterial pressure goal in hypertensive patients: a pilot study. *J Hum Hypertens.* May 2007;21(5):347-352.
 56. Goertz CH, Grimm RH, Svendsen K, Grandits G. Treatment of Hypertension with Alternative Therapies (THAT) Study: a randomized clinical trial. *J Hypertens.* Oct 2002;20(10):2063-2068.
 57. Reid SA, Rivett DA. Manual therapy treatment of cervicogenic dizziness: a systematic review. *Man Ther.* Feb 2005;10(1):4-13.
 58. Rothwell DM, Bondy SJ, Williams JI. Chiropractic manipulation and stroke: a population-based case-control study. *Stroke.* May 2001;32(5):1054-1060.
 59. Cassidy JD, Boyle E, Cote P, et al. Risk of vertebrobasilar stroke and chiropractic care: results of a population-based case-control and case-crossover study. *Spine.* Feb 15 2008;33(4 Suppl):S176-183.
 60. Choudhry N, Milstein A. *Do Chiropractic Physician Services for Treatment of Low-Back and Neck Pain Improve the Value of Health Benefit Plans? An Evidence-Based Assessment of Incremental Impact on Population Health and Total Healthcare Spending.* San Francisco: Mercer Health and Benefits; 2009.
 61. Sarnat RL, Winterstein J. Clinical and cost outcomes of an integrative medicine IPA. *J Manipulative Physiol Ther.* Jun 2004;27(5):336-347.
 62. Sarnat RL, Winterstein J, Cambron JA. Clinical utilization and cost outcomes from an integrative medicine independent physician association: an additional 3-year update. *J Manipulative Physiol Ther.* May 2007;30(4):263-269.
 63. Manga P, Angus D, Papadopoulos C, Swan WR. *A study to examine the effectiveness and cost-effectiveness of chiropractic management of low-back pain.* Ottawa: Ministry of Health, Government of Ontario; 1993.
 64. Manga P. *Enhanced chiropractic coverage under OHIP as a means of reducing healthcare costs, attaining better health outcomes and achieving equitable access to health services. Report to the Ontario Ministry of Health.* Ottawa: Ministry of Health, Government of Ontario; 1998.
 65. Redwood D, Globe G. Prevention and health promotion by chiropractors. *Am J Lifestyle Med.* 2008;2:537-545.