

Chiropractic Treatment for Geriatric Patients Suffering From Musculoskeletal Conditions

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Abstract

Objective: To overview and analyse the most recent literature concerning the efficacy and effectiveness of chiropractic treatment for geriatric patients suffering from musculoskeletal (MSK) conditions. Emphasis was given to articles that focused specifically on the treatment of low back pain (LBP) and osteoarthritis (OA) in the older adults. Chiropractic adjustments (aka spinal manipulative therapy) and other most common conservative and non-invasive therapies utilized by chiropractors, including physical activity/exercise, nutritional counselling and acupuncture have been reviewed.

Method: An electronic search for relevant literature was conducted on the Google Scholar, Pub Med, Index of Chiropractic Literature, AMED, Medline, and MANTIS/Chiro Access from 2000 up to 2014. Search terms consisted of combinations of musculoskeletal pain, low back pain, osteoarthritis, geriatrics, aging population, aged or elderly or older adult along with a combination of the following terms: alternative treatment, conservative treatment, spinal manipulative therapy, acupuncture, exercise, and nutritional counselling.

Conclusion: Chiropractors are well-positioned to deliver multimodal care, including spinal manipulative therapy (SMT), physical therapy/exercises, nutritional counselling and acupuncture to older adults. Trial of chiropractic care for management of low back pain in older adults has been supported by controlled studies. Chiropractic adjustments have been either recommended or considered to be appropriate for the older adults by the Agency for Health Care Policy and Research (AHCPR) and the American Geriatric Society Panel Guidelines for the Management of Chronic Pain (AGS-PGMCP). Even though there are various lower-force chiropractic manual therapy techniques available as safe alternatives to drugs and surgery, more research is needed on the efficacy and safety of these techniques for management of MSK pain in geriatric patients.

Keywords: *Musculoskeletal Pain; Lower back pain; Osteoarthritis; Degenerative joint disease; Chiropractic care; Spinal manipulative therapy; Physical activity; Exercise; Acupuncture; Nutritional counselling; Geriatric; Elderly; Quality of life*

The purpose of this paper is to review recent literature in regard to chiropractic treatment for geriatric patients suffering from musculoskeletal conditions, with emphasis given to osteoarthritis and chronic low back pain. It will be submitted to PAIN® journal for review and possibly publication. PAIN® is the official publication of the International Association for the Study of Pain (IASP®). This internationally recognized Journal contains material pertinent to specialists and general practitioners addressing all aspects of pain management. It publishes original research and comprehensive reviews on the nature, mechanisms, and treatment of pain. It also provides a multidisciplinary forum for the dissemination of research in the basic and clinical sciences related to pain. In addition IASP® promotes assessment and management of pain based on biopsychosocial (BPS) model emphasizing on multidisciplinary/interdisciplinary approaches. In order to have a forum for clinicians and researchers with specific interests to discuss highly specific issues in depth, IASP® created Special Interest Groups (SIGs) for members. In fact the multidisciplinary forum and SIGs are the strength of the IASP® and PAIN® journal and it

lies in the diversity of the clinical expertise of IASP® membership. Two of the SIGs relevant to this paper are “Musculoskeletal Pain” and “Pain in Older Persons”.

Introduction

MSK symptoms increase with age. Thirty per cent of Canadian seniors aged 75 years and older report suffering from mild, moderate, or severe pain and 47.1% of Canadian people age 65 and over state they have been diagnosed with arthritis [1]. Worldwide, MSK conditions are the most common causes of severe long-term pain and physical disability. Joint diseases account for half of all chronic conditions in people aged 60 and over. Twenty-five per cent of people over age 60 have significant pain and disability from OA [2].

LBP is also very common in geriatric population with reported prevalence in ambulatory settings ranging from 12.8% to 51% [3]. The true prevalence of back pain in the elderly is likely underestimated due to various barriers to reporting such as cognitive impairment, depression, altered pain perception, or focus on co-morbidity. In addition, the elderly patients may not report musculoskeletal pain due to a wish not to burden caregivers or resignation to the perceived effects of aging. Back problems rank third for women and fourth for men as a leading cause of chronic health problems in adults over age sixty-five [3].

Pain and functional limitation from MSK disorders (mainly OA), can profoundly affect the quality of life of older adults. In fact MSK disorders are the fourth most common cause of disability-adjusted life years [2]. At least 25% of elderly Canadians have some activities of daily living limited by MSK pain [1]. Living with MSK pain affects mobility, functional and social independence, activities of daily living, and sleep patterns. It can lead to increased prescription and over-the-counter drug usage. Poly-pharmacy may increase the likelihood of drug-related problems which in turn negatively impacts older adults' health-related quality of life [4]. Finally, pain from MSK conditions has the potential to affect psychological well-being as pain is an important predictor of depression [5].

There is increasing trend in treatment of MSK conditions in older adults by complementary alternative medicine approaches (CAM) methods. A recent study showed that 41% of seniors reported using a CAM treatment and that chiropractic care comprised 20% of those treatments received. In this study, 80% of these people reported that they had received a substantial benefit from their use of CAM [6]. Another study reports that chiropractic care was the most frequent therapy at 11% of the 30% of people 65 and older that used at least one alternative medicine modality in the preceding year [7]. Nearly 20% of them had visits over a two-year period, while 38% had visits spanning three or more calendar years, indicating substantial heterogeneity in the consistency of chiropractic use over time [8]. Chiropractic adjustments have been either recommended or considered to be appropriate for the older adults by AHCPR and AGS-PGMCP [9]. By increasing the number of older adults presenting to chiropractic practices, it is imperative that chiropractors not only discuss the patient's current complaints, but also preventive strategies including fall prevention, nutritional counseling and physical activity. As the population continues to age there will be a greater need for the chiropractic profession to meet the needs of the older adults [10].

Chiropractic Care

Many older adults utilize chiropractic services throughout the US and Canada. A recent longitudinal study reported 14.6% utilization over a 15 year period (1993-2007) with an annual prevalence rate of between 4.1%-5.4% [11]. The most common reason for older adults to seek chiropractic care is MSK pain, most often LBP [12]. Although chiropractic encompasses many different treatment modalities, the focus of this paper will be specifically on interventions that are commonly utilized by Chiropractors: SMT, physical activity/exercise, nutritional counseling and acupuncture. [13]. Treatment approaches used by chiropractors to treat older adults vary widely. Most chiropractors utilize some form of SMT. More than 90% provide nutritional advice and recommend nutritional supplements such as glucosamine sulphate, chondroitin, MSM, etc. Most also recommend therapeutic exercises and recommend patients to engage in physical activity [13]. There is also a growing trend in the utilization of acupuncture in older adults by chiropractors [14].

Spinal Manipulative Therapy (SMT)

From the perspective of the public, chiropractic care is most closely associated with SMT, which is traditionally high-velocity, low-amplitude (HVLA) maneuvers applied manually to spinal and peripheral joints [15]. These maneuvers move the joints from the end of their active and passive ranges of motion into the para-physiological joint space, but not beyond their limit of anatomic integrity to

deliver a therapeutic stimulus to the joint complex [15-18]. The theoretical framework from which hypotheses about the neurophysiological effects of spinal manipulation can be developed is based on an experimental body of evidence indicating that SMT impacts primary afferent neurons from para-spinal tissues, the motor control system and pain processing [18]. Improvements in the knowledge of the mechanism of action of SMT suggest that at least three anatomic effects should be sought on the side of the pain (determined by the physical examination) [18]:

- a. Separation of the facet joint surfaces,
- b. Stretching of the para-spinal muscles (and psoas muscle at the lumbar level)
- c. Lowering of the intra-discal pressure

Selection of the optimal type of manipulation for a given patient should be determined based on these goals [18]. There are different SMT techniques used by chiropractors in practice. These techniques may include varying levels of biomechanical force, ranging from high-velocity, low-amplitude to low-velocity, low-amplitude. SMT may also include instrument-assisted manipulation (Eg: activator), use of specialized tables (Eg: Cox Flexion-Distraction), use of padded wedges and many low-force techniques [13]. Alteration of SMT techniques may play an important role in older adults where variation in technique and application of force is important for prevention of injury associated with a SMT especially in osteoporotic patients. Therefore, there is a need for further research to determine the most appropriate approach in geriatric population. There are two trials that have compared outcomes in older adults comparing a higher force technique versus a lower force technique; both of these trials demonstrated comparable results with both techniques [19,20].

There is a limited but suggestive body of knowledge that supports the effectiveness of SMT for many conditions affecting older patients with spinal and peripheral joint pain and associated dysfunction [21, 22]. This body of knowledge includes expert opinion, case reports, case series, observational studies and a few randomized controlled trials [22]. The majority of studies evaluated the role of SMT for musculoskeletal pain syndromes including lower back pain with and without stenosis [20-24]. There are a number of case reports and case series describing successful management of older patients with spinal or peripheral joint pain by low-velocity, low-amplitude (LVLA) mobilization techniques, HVLA SMT and other low force techniques [25]. Observational studies and randomized controlled trials have reported improvement of spinal pain (acute, sub-acute and chronic) among seniors using not only SMT but also low force techniques such as Cox Flexion-Distraction technique [19] and Bio-Energetic Synchronization Technique [20]. The 2010 UK Report of Manual Therapies reported SMT as an effective treatment for acute, sub-acute, and chronic low back pain in older adults, and found manipulation/mobilization effective for several extremity joint conditions in geriatric population [26]. In addition to spinal OA, there is a limited body of evidence reporting on the role of SMT to address symptoms associated with non-spinal OA involving the knee [27] and the hip [28]. This body of evidence is limited in that it is chiefly comprised of descriptive studies—case reports and case series. Since there is lack of high quality trials reporting on these conditions, there is a need to further investigate the role of SMT in the older adult for non-spine related OA.

Physical activity and exercise

Physical rehabilitation and prescription of therapeutic exercises are vital to improving functional outcomes in the older patient. Exercise can improve gait, balance, coordination, proprioception, reaction time, and muscle strength even in very old and frail elderly people. Increasing and maintaining physical activity is also important in the management of persistent pain in older adults because physical inactivity is common in this population and it can endanger their independence and quality of life, with reduced levels of fitness and function leading to increased levels of disability [29]. The majority of chiropractors report recommendation of physical activity and utilization of therapeutic exercises for their older adult patients [13]. Position statements for osteoarthritis recommend exercise as a key component of disease management [30]. Painful limitation of function and sarcopenia (*i.e.*, loss of muscle) are two common reasons for the utilization of exercises in geriatric population. The loss of muscle strength has been identified as a physiologically limiting factor to living independently among older persons [31]. Recent reviews have shown the positive effects of aerobic exercise and strength

and strength training on strength, balance, and physical functioning [32]. These reviews demonstrate a modest beneficial effect of resistive training on strength outcomes and strong evidence for the improving function, particularly gait speed and chair stands. There are a few studies evaluating long term improvements in disability in older patients who undergo resistance training specifically [33]. There are also strong data supporting the role of resistance exercise in improving pain associated with knee OA [34]. A recent study reported lower levels of pain-related disability in community dwelling older adults who were adherent to an adaptive physical activity program [35]. Chronic LBP is a common problem among the older adult population and the most common condition for which they seek chiropractic care. Recent studies have demonstrated the benefits of exercise alone [36], combined with SMT [37] and combined with cognitive-behavioural therapy [38] for management of chronic LBP in older adults. A recent systematic review found that there is moderate evidence on the use of exercise for fall prevention [39] and balance [40] in older adults. Another systematic review found that interventions with balance exercises reduced falls or fall-related fractures and improved balance in the majority of the studies reviewed [41]. Muscle strengthening exercises were also found to be effective in improving lower extremity strength and back extensor strength. Bone strength was improved by weight-bearing aerobic exercise with or without muscle strengthening exercise when the duration of the intervention was at least a year [41].

Although the literature supports exercise as one of the most effective interventions for community-dwelling older adults, all risk factors must be assessed and triaged appropriately [42]. A recent review article found that among 121 trials identified, 53 trials provided no comments about adverse events, 25 trials reported no adverse events occurred, and 43 trials reported some types of adverse events [43]. Most adverse events reported were musculoskeletal problems such as muscle strain or joint pain, and were reported more often in trials that recruited participants with certain health conditions, functional limitations, or sedentary lifestyle [43]. Since the key point is to get older people moving, they should be encouraged to participate in activities they enjoy.

Nutritional counselling

Studies report that prevention strategies in the form of improvement in diet and health promotion counseling can lead to improved quality of life, significant reductions in disability, and reduction in health care costs [44,45]. The main goal for nutritional counseling in older adults should be improvement of food choices, particularly with respect to increasing the intake of fruits and vegetables [44]. Current research indicates that a large percentage of older adults do not receive adequate amounts of micronutrients in their daily diet [46, 47]. Thus if consumption of adequate micronutrients cannot be managed with dietary modification, the use of dietary supplements may be considered. However, due to lack of rigorous clinical trials regarding evaluation of dietary supplements' effectiveness, it is difficult to make strong recommendations for or against nutritional supplements for meeting the nutritional needs of older adults. Although multivitamin-mineral (MVM) supplements are used commonly by older adults, there is limited evidence of their impact on health outcomes [48]. Vitamin D and calcium supplements appear to have the most beneficial effects [49,50]. They have been found to be a critical adjunct to any pharmacotherapy of osteoporosis [50]. In addition, a recent systematic review on Vitamin D found that it effectively reduces the risk of falls in older adults [51].

The most common nutritional supplements used by chiropractors for different MSK conditions are glucosamine, chondroitin sulfate, and methyl-sulfonyl-methane (MSM). Although these supplements are occasionally recommended for patients with degenerative joint disease (DJD) of spine and/or other joints, the evidence supporting their use is unknown [52]. In 2006, Glucosamine/Chondroitin Arthritis Intervention Trial (GAIT) study investigators demonstrated that the popular combination of glucosamine and chondroitin did little to alleviate the progression of disease or pain in people with mild to moderate knee OA [53]. Sherman, *et al.* [54] reviewed both the positive and negative findings of published studies regarding the proposed benefits of these supplements in the prevention and/or treatment of OA pain and came to conclusion that a trial of glucosamine coupled with chondroitin seems warranted in persons with OA who have not responded to other treatment options [54]. There is an inadequate amount of literature examining the use of these supplements for lumbar spinal degenerative conditions compared to the volume available pertaining to their use for knee or hip OA,

and therefore further research is necessary to clarify if these supplements are of any potential benefit for patients with spinal degenerative conditions [52].

Acupuncture

Rooted in traditional Chinese medicine, acupuncture refers to any of a variety of interventions that are administered using acupuncture needles to stimulate anatomical points [55]. This includes but is not limited to traditional Chinese acupuncture, percutaneous electrical nerve stimulation (PENS), auricular acupuncture, trigger point deactivation, and deep intramuscular electrical stimulation [10].

There have been no trials conducted in which chiropractors have delivered the acupuncture to older adults. However, there are trials that have specifically focused on older adults with LBP, *i.e.*, the most common presentation of older adults to chiropractors. A review by Staud [56] found several randomized trials have provided strong evidence for beneficial acupuncture effects on chronic LBP and pain from knee OA in general. However, in regard to geriatric patients, these studies have been inconsistent and contradictory. While older adults have been included in some trials evaluating the efficacy of acupuncture for the treatment of LBP, only two have focused exclusively on older adults. These studies have evaluated the more contemporary acupuncture technique of PENS. The first one was a randomized controlled pilot trial involving 34 community dwelling older adults with chronic LBP who received either lumbar PENS or a control procedure: acupuncture needles without electrical stimulation [57]. Both groups also received physical therapy. Those randomized to lumbar PENS experienced significant pain reduction and functional improvement lasting for three months. However the control group experienced no improvement. The second study was a randomized controlled trial of 200 older adults with chronic LBP who received one of four interventions:

- a. Lumbar PENS and a general conditioning and aerobic exercise (GCAE) program
- b. Lumbar PENS alone
- c. Limited lumbar PENS (only 2 of 12 needles were stimulated for 5 minutes as compared with full PENS during which all needles were stimulated for 30 minutes)
- d. Limited lumbar PENS and GCAE.

Participants were followed for 6 months and all four groups experienced significant improvement that was maintained during the follow-up period [58]. In addition to treatment for LBP, other studies have evaluated the role of acupuncture for other conditions. A recent review reported that there is insufficient experimental evidence to recommend the use of traditional Chinese acupuncture over other modalities for older adults with persistent musculoskeletal pain [59]. A 2010 systematic review with a meta-analysis of controlled clinical trials of the efficacy of acupuncture in the management of fibromyalgia concluded that there is a small analgesic effect of acupuncture in fibromyalgia pain, but that such benefit was not clearly distinguishable from bias [60].

Discussion

Chiropractic can play an important role in the management of MSK conditions in the older adults. Although chiropractic care has often been associated only with the management of MSK disorders by the application of SMT, as discussed in this article, chiropractors often utilize multiple treatment modalities that address the patient as a whole, not only his or her MSK symptoms. The management of older adults is complicated by many factors such as comorbidities that may limit the type of treatment intervention employed. These co-morbidities include concerns of osseous weakness, interaction of nutritional supplements with current prescription medication as well as concerns about fall risk. It is also important to spend extra time with the older adults in order to appropriately manage this population. A recent survey discussed the barriers to such things as fall prevention discussions with older adults [61]. In addition there are concerns about the amount of time that should be taken to appropriately educate the older adult concerning exercise recommendations [62]. There is a strong case to be made for the role of multidisciplinary care in the older adult with MSK pathology, however to achieve this practicing chiropractors must develop relationships with other health care providers. This integrated care model has been described and has the potential to improve the overall role of chiropractic in the healthcare system [63].

There is concern about risk in the chiropractic management of the older adults, so there is a need for systematic evaluation of the risks associated with any chiropractic management strategy, particularly SMT. Once the risks have been ruled out, chiropractors can choose from a wide variety of treatment approaches within the chiropractic scope of practice, while being sensitive to patient preferences. The role of chiropractors in delivering acupuncture remains controversial, and there is also a need for research further defining the role of acupuncture in the management of older adults. By increasing number of older adults seeking chiropractic care, it is imperative that chiropractors not only discuss the patient's current complaints, but also preventive strategies including fall prevention, nutritional counseling and physical activity. In the future there will be a greater need for the chiropractic profession to meet the needs of the older adults as the population continues to age.

Summary

Best practice dictates a multimodal approach to care in all patients, particularly the geriatric population. Chiropractors are well-positioned to deliver multimodal care, including SMT, physical therapy/exercise, nutritional counselling and acupuncture to older adults.

There is a limited but suggestive body of knowledge (expert opinion, case reports, case series, observational studies and a few randomized controlled trials) that supports the effectiveness of SMT for many conditions affecting older patients with spinal and peripheral joint pain and associated dysfunction [21,22]. The majority of studies evaluated the role of SMT for musculoskeletal pain syndromes including lower back pain with and without stenosis [20-24]. There are a number of case reports and case series describing successful management of older patients with spinal or peripheral joint pain by mobilization and other low force techniques [25]. Observational studies and randomized controlled trials have reported improvement of spinal pain (acute, subacute and chronic) among seniors using not only SMT but also low force techniques such as Cox Flexion-Distracton technique [19] and Bio-Energetic Synchronization Technique [20]. The 2010 UK Report of Manual Therapies found manipulation/mobilization effective for several extremity joint conditions in geriatric population [26]. In addition to spinal OA, there is a limited body of evidence reporting on the role of SMT to address symptoms associated with non-spinal OA involving the knee [27] and the hip [28].

A recent study reported lower levels of pain-related disability in community dwelling older adults who were adherent to an adaptive physical activity program [35]. Recent studies have demonstrated the benefits of exercise alone [36], combined with SMT [37] and combined with cognitive-behavioural therapy [38] for management of chronic LBP in older adults. There are also strong data supporting the role of resistance exercise in improving pain associated with knee OA [34].

The most common nutritional supplements used by chiropractors for different MSK conditions are glucosamine, chondroitin sulfate, and methyl-sulfonyl-methane (MSM). There is no evidence supporting their effectiveness in patients with degenerative joint disease (DJD) of spine and/or other joints [52]. Glucosamine/Chondroitin Arthritis Intervention Trial (GAIT) study investigators demonstrated that the popular combination of glucosamine and chondroitin did little to alleviate the progression of disease or pain in people with mild to moderate knee OA [53]. Sherman, *et al.* [54] came to conclusion that a trial of glucosamine coupled with chondroitin seems warranted in persons with OA who have not responded to other treatment options.

Conclusion

While older adults have been included in some trials evaluating the efficacy of acupuncture for the treatment of LBP, only two have focused exclusively on older adults. These studies have evaluated the more contemporary acupuncture technique of PENS. Both of the studies reported significant pain reduction and lasting functional improvement in older adults [57,58]. There is insufficient experimental evidence to recommend the use of traditional Chinese acupuncture over other modalities for older adults with persistent musculoskeletal pain [59]. A 2010 systematic review with a meta-analysis of controlled clinical trials of the efficacy of acupuncture in the management of fibromyalgia concluded that there is a small analgesic effect of acupuncture in fibromyalgia pain, but that such benefit was not clearly distinguishable from bias [60].

Bibliography

1. Statistics Canada. "Population Aging and the Elderly 1993; National Population Health Survey 2001". *Canadian Community Health Survey 2000/01*.
2. Brooks PM. "Impact of osteoarthritis on individuals and society: how much disability? Social consequences and health economic implications". *Current Opinion in Rheumatology* 14.5 (2002): 573-577.
3. Hoy D., et al. "A Systematic Review of the Global Prevalence of Low Back Pain". *Arthritis & Rheumatism* 64.6 (2012): 2028-2037.
4. Ernst ME., et al. "Drug-related problems and quality of life in arthritis and low back pain sufferers". *Value in Health* 6.1 (2003): 51-58.
5. Carroll LJ., et al. "Factors associated with the onset of an episode of depressive symptoms in the general population". *Journal of Clinical Epidemiology* 56.7 (2003): 651-658.
6. Astin JA., et al. "Complementary and alternative medicine use among elderly persons: one-year analysis of a blue shield medicare supplement". *Journal of Gerontology: A-Biological Sciences & Medical Sciences* 55.1 (2000): M4-9.
7. Alcantara J., et al. "Chiropractic care of a geriatric patient with an acute fracture-subluxation of the eighth thoracic vertebra". *Journal of Manipulative and Physiological Therapeutics* 27.3 (2004): E4.
8. Killinger LZ. "Chiropractic and geriatrics: a review of the training, role, and scope of chiropractic in caring for aging patients". *Clinical Geriatrics Medicine* 20.2 (2004): 223-235.
9. Weigel P., et al. "A longitudinal study of chiropractic use among older adults in the United States". *Chiropractic & Osteopathy* 18.34 (2010): 18-34.
10. Dougherty PE., et al. "The role of chiropractic care in older adults". *Chiropractic & Manual Therapies* 20.1. (2012): 3.
11. Coulter ID., et al. "Patients using chiropractors in North America: who are they, and why are they in chiropractic care?" *Spine* 27.3 (2002): 291-296, discussion 297-298.
12. Hawk C., et al. "Best practices recommendations for chiropractic care for older adults: results of a consensus process". *Journal of Manipulative and Physiological Therapeutics* 33.6 (2010): 464-473.
13. "Practice Analysis of Chiropractic by National Board of Chiropractic Examiner (NBCE)". Accessed: April 28, 2014.
14. Votova K and Wister AV. "Self-care dimensions of complementary and alternative medicine use among older adults". *Gerontology* 53.1 (2007): 21-27.
15. Evans DW. "Mechanisms and effects of spinal high-velocity, low-amplitude thrust manipulation: Previous theories". *Journal of Manipulative and Physiological Therapeutics* 25.4 (2002): 251-262.
16. Pickar JG. "Neurophysiological effects of spinal manipulation". *The Spine Journal* 2.5 (2002): 357-371.
17. Cramer G., et al. "Basic science research related to chiropractic spinal adjusting: the state of the art and recommendations revisited". *Journal of Manipulative and Physiological Therapeutics* 29.9 (2006): 726-761.
18. Maigne JY and Vautravers P. "Mechanism of action of spinal manipulative therapy". *Joint Bone Spine* 70.5 (2003): 336-341.
19. Hondras MA., et al. "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". *Journal of Manipulative and Physiological Therapeutics* 32.5 (2009): 330-343.
20. Hawk C., et al. "Comparison of Bio-Energetic Synchronization Technique and customary chiropractic care for older adults with chronic musculoskeletal pain". *Journal of Manipulative and Physiological Therapeutics* 29.7 (2006): 540-549.
21. Bokarius AV and Bokarius V. "Evidence-based review of manual therapy efficacy in treatment of chronic musculoskeletal pain". *Pain Practice* 10.5 (2010): 451-458.
22. Gleberzon BJ. "A narrative review of the published chiropractic literature regarding older patients from 2001-2010". *Journal of Canadian Chiropractic Association* 55.2 (2011): 76-95.
23. Stuber K., et al. "Chiropractic treatment of lumbar spinal stenosis: a review of the literature". *Journal of Chiropractic Medicine* 8.2 (2009): 77-85.
24. Roberts JA and Wolfe TM. "Chiropractic spinal manipulative therapy for a geriatric patient with low back pain and comorbidities of cancer, compression fractures, and osteoporosis". *Journal of Chiropractic Medicine* 11.1 (2012): 16-23.

25. Mykietiuik C., *et al.* "Technique Systems used by post-1980 graduates of the Canadian Memorial Chiropractic College practicing in five Canadian provinces: a preliminary survey". *Journal of Canadian Chiropractic Association* 53.1 (2009): 32-39.
26. Bronfort G., *et al.* "Effectiveness of manual therapies: the UK evidence report". *Chiropractic & Osteopathy* 18 (2010): 3.
27. Law A. "Diversified chiropractic management in the treatment of osteoarthritis of the knee". *Journal of Canadian Chiropractic Association* 45.4 (2001): 232-240.
28. Strunka RG, and Hanses, M. "Chiropractic care of a 70-year-old female patient with hip osteoarthritis". *Journal of Chiropractic Medicine* 10.1 (2011): 54-59.
29. Abdulla A., *et al.* "Guidance on the management of pain in older people". *Age and Aging* 42.Suppl 1 (2013): i1-i57.
30. Keysor JJ, and Brembs, A. "Exercise: necessary but not sufficient for improving function and preventing disability?" *Current Opinion in Rheumatology* 23.2 (2011): 211-218.
31. Reid KF, *et al.* "Lower extremity muscle mass predicts functional performance in mobility limited elders". *Journal of Nutrition, Health and Aging* 12.7 (2008): 493-498.
32. Mangione KK, *et al.* "Cochrane review: Improving physical function and performance with progressive resistance strength training in older adults". *Physical Therapy* 90.12 (2010): 1711-1715.
33. Liu CJ and Latham N. "Can progressive resistance strength training reduce physical disability in older adults? A meta-analysis study". *Disability and Rehabilitation* 33.2 (2011): 87-97.
34. Latham N and Liu CJ. "Strength training in older adults: the benefits for osteoarthritis". *Clinics in Geriatric Medicine* 26.3 (2010): 445-459.
35. Hicks GE., *et al.* "Adherence to a community-based exercise program is a strong predictor of improved back pain status in older adults: an observational study". *Clinical Journal of Pain* 28.3 (2012): 195-203.
36. Mailloux J., *et al.* "Long-term exercise adherence in the elderly with chronic low back pain". *American Journal of Physical Medicine & Rehabilitation* 85.2 (2006): 120-126.
37. Maiers MJ., *et al.* "Chiropractic and exercise for seniors with low back pain or neck pain: the design of two randomized clinical trials". *BMC Musculoskeletal Disorders* 8 (2007): 94.
38. Beissner K., *et al.* "Implementing a combined cognitive-behavioral + exercise therapy protocol for use by older adults with chronic back pain: evidence for a possible race/ethnicity effect". *Journal of Aging and Physical Activity* 20.2 (2012): 246-265.
39. Michael YL., *et al.* "Primary care relevant interventions to prevent falling in older adults: a systematic evidence review for the U.S. Preventive services task force". *Annals of Internal Medicine* 153.12 (2010): 815-825.
40. Hawk C and Cambron J. "Chiropractic Care for Older Adults: Effects on Balance, Dizziness, and Chronic Pain". *Journal of Manipulative and Physiological Therapeutics* 32.6 (2009): 431-437.
41. de Kam D., *et al.* "Exercise interventions to reduce fall-related fractures and their risk factors in individuals with low bone density: a systematic review of randomized controlled trials". *Osteoporosis International* 20.12 (2009): 2111-2125.
42. Shubert TE. "Evidence-Based Exercise Prescription for Balance and Falls Prevention: A Current Review of the Literature". *Journal of Geriatric Physical Therapy* 34.3 (2011): 100-108.
43. Liu CJ and Latham N. "Adverse events reported in progressive resistance strength training trials in older adults: 2 sides of a coin". *Archives of Physical Medicine and Rehabilitation* 91.9 (2010): 1471-1473.
44. Chernoff R. "Nutrition and health promotion in older adults". *Journal of Gerontology: A-Biological Sciences & Medical Sciences* 56.Spec No 2 (2001): 47-53.
45. Bartali B., *et al.* "Low micronutrient levels as a predictor of incident disability in older women". *Archives of Internal Medicine* 166.21 (2006): 2335-2340.
46. Sebastian RS., *et al.* "Older adults who use vitamin/mineral supplements differ from nonusers in nutrient intake adequacy and dietary attitudes". *Journal of the American Dietetic Association* 107.8 (2007): 1322-1332.
47. Ahmed T and Haboubi N. "Assessment and management of nutrition in older people and its importance to health". *Clinical Interventions in Aging* 5 (2010): 207-216.

48. Mackowiak ED, *et al.* "The adult vitamin and mineral supplement maze". *The Consultant Pharmacist* 25.4 (2010): 234-240.
49. Park S, *et al.* "Vitamin and mineral supplements: barriers and challenges for older adults". *Journal of Nutrition for the Elderly* 27.3-4 (2008): 297-317.
50. Buhr G and Bales CW. "Nutritional supplements for older adults: review and recommendations-part I". *Journal of Nutrition for the Elderly* 28.1 (2009): 5-29.
51. Kalyani RR, *et al.* "Vitamin D treatment for the prevention of falls in older adults: systematic review and meta-analysis". *Journal of American Geriatric Society* 58.7 (2010): 1299-1310.
52. Stuber K, *et al.* "Efficacy of glucosamine, chondroitin, and methylsulfonylmethane for spinal degenerative joint disease and degenerative disc disease: a systematic review". *Journal of Canadian Chiropractic Association* 55.1 (2011): 47-55.
53. Clegg DO, *et al.* "Glucosamine, chondroitin sulfate, and the two in combination for painful knee osteoarthritis". *New England Journal of Medicine* 354.8 (2006): 795-808.
54. Sherman AL, *et al.* "Use of glucosamine and chondroitin in persons with osteoarthritis". *Physical Medicine and Rehabilitation* 4.5 Suppl (2012): S110-116.
55. Hashefi M, *et al.* "Nonpharmacologic, Complementary, and Alternative Interventions for Managing Chronic Pain in Older Adults". *Clinical Geriatrics* 21.3 (2013): Online Issue.
56. Staud R. "Mechanisms of acupuncture analgesia: effective therapy for musculoskeletal pain?" *Current Rheumatology Report* 9.6 (2007): 473-481.
57. Weiner DK, *et al.* "Efficacy of percutaneous electrical nerve stimulation for the treatment of chronic low back pain in older adults". *Journal of American Geriatric Society* 51.5 (2003): 599-608.
58. Weiner DK, *et al.* "Efficacy of percutaneous electrical nerve stimulation and therapeutic exercise for older adults with chronic low back pain: a randomized controlled trial". *Pain* 140.2 (2008): 344-357.
59. Weiner DK, and Ernst, E. "Complementary and alternative approaches to the treatment of persistent musculoskeletal pain". *Clinical Journal of Pain* 20.4 (2004): 244-255.
60. Langhorst J, *et al.* "Efficacy of acupuncture in fibromyalgia syndrome--a systematic review with meta-analysis of controlled clinical trials". *Rheumatology (Oxford)* 49.4 (2010): 778-788.
61. Chou W C, *et al.* "Perceptions of physicians on the barriers and facilitators to integrating fall risk evaluation and management into practice". *Journal of General Internal Medicine* 21.2 (2006): 117-122.
62. Schneider H and Cristian A. "Role of rehabilitation medicine in the management of pain in older adults". *Clinics in Geriatric Medicine* 24.2 (2008): 313-334.
63. Murphy DR, *et al.* "How can chiropractic become a respected mainstream profession? The example of podiatry". *Chiropractic & Osteopathy* 16.10 (2008): 10.

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