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A systematic review of chiropractic management of adults with whiplash-associated disorders: Recommendations for advancing evidence-based practice and research

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Abstract. The literature relevant to the treatment of Whiplash-Associated Disorders (WAD) is extensive and heterogeneous. Methods: A Participatory Action Research (PAR) approach was used to engage a chiropractic community of practice and stakeholders in a systematic review to address a general question: 'Does chiropractic management of WAD clients have an effect on improving health status?' A systematic review of the empirical studies relevant to WAD interventions was conducted followed by a review of the evidence. Results: The initial search identified 1,155 articles. Ninety-two of the articles were retrieved, and 27 articles consistent with specific criteria of WAD intervention were analyzed in-depth. The best evidence supporting the chiropractic management of clients with WAD is reported. Further review identified ways to overcome gaps needed to inform clinical practice and culminated in the development of a proposed care model: the WAD–Plus Model. Conclusions: There is a baseline of evidence that suggests chiropractic care improves cervical range of motion (cROM) and pain in the management of WAD. However, the level of this evidence relevant to clinical practice remains low or draws on clinical consensus at this time. The WAD-Plus Model has implications for use by chiropractors and interdisciplinary professionals in the assessment and management of acute, subacute and chronic pain due to WAD. Furthermore, the WAD-Plus Model can be used in the future study of interventions and outcomes to advance evidence-based care in the management of WAD.

Keywords: Pain, neck, treatment, manipulation, assessment

1. Introduction

Whiplash-Associated Disorders (WAD) are a major health problem that disrupt the daily and work lives of

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people around the world [11]. For people experiencing WAD, one of the primary concerns is the debilatory nature of pain. Thus, knowledge that can support the efficient and effective management and recovery from WAD is needed to enable persons to resume meaningful participation in family and work life, as well as support clinicians, such as chiropractors, in delivering evidence-based approaches to the management of WAD. The chiropractic community has traditionally provided leadership in the interventions that support recovery and the management of pain for those with WAD.

Historically, the profession of chiropractic has contributed to the development of a knowledge base supporting the treatment and management of WAD. Published documents, inquiries, and expert knowledge have provided a backdrop for WAD treatment and care. For instance, several texts developed by chiropractors inform the education of new chiropractors in the management of WAD [9,21,41,48]. Moreover, these texts are widely used within the profession as they provide the basis for understanding the etiology of WAD, as well as the assessment, evaluation and treatment decisions underscoring chiropractic practice. Experientially, the outcome of treatment of WAD is well known in the field of chiropractic and to clients. However, there is a new factor promoting a paradigm shift in the body of knowledge used to guide the management of WAD: that of evidence-based knowledge. This change is a reflection of a growing expectation and subsequent tension in the health disciplines, including chiropractic, to adopt and use research-based knowledge to inform treatments and decision-making in practice. The profession and discipline of chiropractic has responded to this expectation through envisioning and committing to a sustainable process for knowledge exchange, synthesis and transfer to support the advancement and use of evidence in practice through the development of guidelines for practice. As part of this ongoing process, the Clinical Practice Guidelines Task Force (CPG TF) and the Guidelines Development Committee (GDC), identified the need to advance evidence-based management of WAD. Moreover, this approach is moving the discipline toward integration of research evidence, with professional expertise and client knowledge in decision-making that is consistent with Sackett's [57] definition of evidence-based practice in the medical and health disciplines. Such an approach to evidence recognizes and values the synthesis of knowledge sources needed in clinical decision-making when addressing the idiosyncratic presentation of clinical and non-clinical findings in caring for clients with WAD.

The available clinical literature on the treatment of WAD is extensive and chiropractors, as well as physical therapists, physicians, surgeons, etc inform the contributions to this knowledge base. However, there is a lack of synthesis of the evidence needed to inform clinical practice guidelines for the chiropractic management of WAD and the resumption of pre-injury activities such as work. This gap was recognized by the CPG TF and the GDC of the chiropractic community in Canada who in turn provided the impetus for developing a process that involved stakeholders (board members of the professional associations, the national professional association the Canadian Chiropractic Association (CCA) and the Canadian Federation of Chiropractic Regulatory, Education and Accrediting Boards (CFCREAB), interprofessional and the chiropractic community such as specialty colleges and organizations interested in the development of Clinical Practice Guidelines, to establish and update clinical guidelines for the chiropractic management of WAD based on the best available evidence. This paper outlines this process and the systematic review conducted to inform clinical guidelines in the chiropractic management of WAD.

2. Background and literature on chiropractic management of WAD

In this paper, WAD is defined as a clinical problem in adult whiplash trauma that occurs with sudden acceleration or deceleration of the head and neck relative to other parts of the body, typically during vehicle collisions or other mishaps. Signs and symptoms of whiplash injury are collectively described as WAD [68]. Whiplash-related symptoms differ from treating other forms of cervical pain as pain outcomes differ between WAD and non-WAD clients [2]. For instance symptoms may include, but are not limited to, neck pain, musculoskeletal signs (such as hyperalgesia, movement loss, neck stiffness, kinaesthetic deficits and balance loss) [69] deafness, dizziness, tinnitus, headache, memory loss, dysphagia and temporomandibular pain [68].

Clients with WAD are graded by the severity of signs and symptoms and the classification of whiplash injury by WAD grade is used routinely in clinical practice to provide an understanding of the condition [68]. For instance, clients with WAD are graded by the severity of signs and symptoms from Grade 0 (no complaints or physical signs after a whiplash event; no WAD) to Grade 4 (fracture or dislocation). Increasing grades of WAD from WAD-1 through WAD-4 define an in-

creasing severity and differential presentation of signs and symptoms. From the standpoint of treatment, each WAD grade is distinct and mutually exclusive. These grades are used to provide a universal understanding by a broad range of users, researchers, health care professionals, insurance and legal systems.

Many clients with WAD recover quickly and completely; however, chronic symptoms or disability affect others (19–60%) [61]. Up to half of WAD-1 or WAD-2 clients suffer neck pain and disability 6 months after injury (i.e. chronic WAD) [30], and almost a quarter of these clients remain symptomatic after 1 year [11]. Chronic WAD accounts for almost half of all whiplash-related costs such as treatment and lost wages [30,54]. Consequently, a foremost treatment goal for WAD is to prevent the progression of acute to chronic symptoms. Yet, the research evidence supporting interventions used to achieve these outcomes is missing and this gap underpins some of the current tensions in advancing evidence-based practice in WAD care. Historically, there were few chiropractors funded to do research. This is changing. There is recent movement towards university-based chiropractic research chairs to lead research efforts to bridge the research to practice gaps.

The most common chiropractic intervention is the adjustment [15], which usually involves High Velocity Low Amplitude (HVLA) manipulation. The practice of spinal manipulation (such as HVLA) is an intervention that dates back to time of the Egyptians and Romans and on up through the centuries to the time of bone setters and finally chiropractors in the late 1800s. As such, the adjustment (or HVLA manipulation), holds its roots not so much in science but in traditional usage much like the use of heat and ice therapies. More recently, chiropractic extrapolates evidence on HVLA for the treatment of WAD from the use of HVLA to treat other types of neck pain. From an "evidence based" perspective, previous work [2,27] suggests that manual therapy (SMT [HVLA] or mobilization) and exercise interventions are more effective than no treatment, sham or some other alternative interventions for neck pain. In the absence of strong evidence to guide clinicians regarding the use of HVLA for WAD, chiropractors have chosen HVLA based on tradition, clinical experience and available data on neck pain treatments. A study by Woodward et al. [77] used a retrospective chart review of 28 chronic whiplash clients, 27 of whom had intrusive or disabling symptoms. Chiropractic care (HVLA manipulation, proprioceptive neuromuscular facilitation, cryotherapy) initiated an average of 16 months after injury was associated with improvement for 26 clients. A limitation of this study is that control subjects were not available for comparison. Beyond this, the extent of other evidence on HVLA manipulation for WAD is unknown.

Pain is a leading symptom of WAD and is addressed by almost all published studies. The International Association for the Study of Pain (IASP) defines pain as "an unpleasant sensory and emotional experience associated with actual or potential tissue damage" [32]. Acute, subacute, and chronic pain are defined clinically based on time since injury. The IASP operationally defines pain lasting more than 3 months as chronic pain [46]. Often, there are few physical abnormalities for subjects whose pain persists for 3 months or longer. By inference, acute pain lasts less than 3 months and subacute pain is used to refer to pain that has persisted for longer than a brief period but not yet 3 months [47]. An actual dividing line between acute and subacute and between subacute and chronic symptoms is unique to each client's clinical situation. Given the current literature on pain, the following definitions and time periods were used to categorize pain in this paper: acute (0–7 days), subacute (1 week to 3 months) and chronic (more than 3 months). Treatment of pain in the management of WAD varies and more effort is needed to provide a comprehensive understanding of evidence-based approaches that chiropractors can use to ameliorate pain and improve health outcomes for persons with WAD.

Others in the global health community are also recognizing and responding to the need to promote research in neck pain. The recent emergence of documents such as the Bone and Joint Decade 2000–2010 Neck Pain Task Force (BJD TF) papers [27] underscores these efforts. In other approaches, insurance claims data are being analyzed to understand the prognosis of whiplash injuries [13,14].

The literature search and analysis in this paper aimed to help move evidence-based knowledge into the hands of chiropractors to support the chiropractic management of WAD. The synthesis of the evidence supports both evidence-informed and GDC consensus recommendations to improve health outcomes. Based upon the evidence, recommendations are also made to advance future research. The main question underscoring this systematic review is: 'Does chiropractic management of WAD clients have an effect on improving health status?' Chiropractic management of WAD in this review was determined by the CPG TF and the GDC to be inclusive of all potential treatment modalities used by manual practitioners. Thus, the literature

search strategy, was not restricted to treatment modalities delivered by chiropractors only, rather a wide net was cast to include treatments that may be administered in chiropractic care, though may be delivered in the context of care by other healthcare professionals in a specific research study (e.g. use of exercise regimens to treat WAD).

3. Methods

Traditionally, systematic reviews of the literature are conducted to inform health care decision-making grounded in research evidence. The end-users of reviews, such as chiropractors, are often left with the daunting task of interpreting the relevance of research evidence to a particular area of practice within a field. In the Canadian chiropractic community, a strategic approach to evidence synthesis was envisioned that adopted a comprehensive knowledge transfer process to support the accessibility and uptake of evidence by end-users [63] through the development of best evidence practice guidelines. This approach used in chiropractic is comprehensive and attests to the commitment of the profession to advance evidence-based practice through engaging a knowledge exchange and transfer process that emphasizes and supports the movement of research knowledge into practice [32,40]. The involvement of the CPG TF and GDC is also consistent with the knowledge transfer literature [33] that suggests that the more engaged health care professionals are in the research process the more likely evidence will be transferred and applied in client care. Further to this, the development of practice guidelines will afford a more efficient and sustainable mechanism to bridge the gap between research knowledge and its use in practice by all chiropractors.

In keeping with a philosophy of participation and the need to develop relevant processes of dissemination consistent with knowledge use in practice, a participatory action research (PAR) approach [67] underpinned the processes of this systematic review and the knowledge transfer efforts. The PAR approach reflects a cycle of *defining the problem*; *planning*; *data generation; data analysis and interpretation; action; and evaluation.*

- *Defining the problem:* The CPG TF identified the need to establish a baseline of evidence on chiropractic care in the management of WAD.
- *Planning:* The GDC then planned for and adapted systematic processes for the extraction, review and analysis of data using source evidence review and best evidence synthesis [64].
- *Data generation:* A systematic review was used to generate data. This review included steps such as identifying scope of search, engaging expert consultation, establishing search terms and rationale, and using specific data extraction and analysis methods.
- *Data analysis and interpretation:* A multi-step process was used to analyze and interpret data. A review team of contributors, who were experts with research and clinical expertise in chiropractic and/or data synthesis, conducted a detailed source evidence analysis. The expert contributor review team and the GDC interpreted the source evidence and conducted the best evidence synthesis relevant to chiropractic treatment and care of WAD.
- *Action:* The GDC developed recommendations for practice, and a WAD-Plus model to promote evidence-based practice in the management of WAD [8].
- *Evaluation:* An iterative process of evaluation included consultation and feedback with the CPG TF and stakeholders on the extent to which the information is easy to understand and appropriate for dissemination and use by chiropractors.

Based on the PAR approach, all participants in this process shaped the direction of this systematic review and contributed to the emergent research processes needed to make sense of the evidence, to synthesize evidence through analysis, to generate practice recommendations, and to identify dissemination strategies. This collaborative and consultative process led to 8 steps of this systematic review and synthesis. These processes dovetailed with the three components fundamental to evidence-based practice combined to inform this work [57]: (1) Evidence extracted from the published literature about effective chiropractic care for adults with WAD, (2) Knowledge of the client; including pain history, culture, gender, age, socioeconomic, psychological, and (3) Chiropractors' clinical experience.

3.1. Basic steps of this systematic review

Literature search

Step 1: Define research question, scope of search and search terms

Step 2: Identify articles and key experts for articles

Step 3: Conduct literature search

Table 1

Search terms	
Intervention Terms	Effect; efficacy; effectiveness; and treatment outcome. Search terms to describe interventions were: management; intervention; manipulation; rehabilitation; manual therapy; chiropractic; physical therapy; physiotherapy; client education; exercise; mobilization; and prevention.
Practice Terms	Whiplash; whiplash-associated disorders; neck injury(ies); neck sprain; and neck strain
Types of treatment or treatment modalities	Rest; relaxation; collar; information; instruction (active education); progressive return to normal activities of daily living (nADL); thermotherapy; hydrotherapy; traction; massage; electrotherapy (pulsed electromagnetic therapy)[PEMF], transcutaneous electrical nerve stimulation [TENS], diathermy, ultrasound); supervised or unsupervised, aerobic, strengthening, endurance or kinesthetic exercise; supervised or unsupervised, passive or active mobilization; McKenzie and Maitland mobilization; high velocity, low amplitude (HVLA) manipulation; psychological support; and cognitive behavioral therapy (CBT)

Selection for relevance

Step 4: Conduct Stage 1a review: Select articles for inclusion using abstracts and titles

Step 5: Conduct Stage 1b review: Extract articles for inclusion using text screening, operational definitions and inclusion criteria

Quality assessment

Step 6: Conduct Stage 2 review: Assess quality of relevant articles

Evidence synthesis and guideline development

Step 7: Extract and analyze treatment and health outcome evidence and conduct synthesis

Step 8: Interpret knowledge and evidence for advancing the management of WAD

The rules and actions for each step in the review and synthesis processes are outlined below. All steps in the review processes were achieved through consensus.

3.2. *Literature search* (*Steps 1,2,3*)

Two literature searches were completed respectively in 2005 (including articles published in English and German) and 2006 (including articles published in English and French) to identify intervention studies relevant to WAD. Three languages were included based on the linguistic fluency of the review team members. Reviews were completed using PubMed (1966 through April 2006), EMBASE, the Cumulative Index to Nursing and Allied Health (CINAHL), the Physiotherapy Evidence Database (PEDro), PsychINFO, and the Cochrane Library. Search terms included in this review are organized in Table 1. Published studies were used as the preferred basis for recommendations, and knowledge based on clinical experience was equivalent to the lowest level of research evidence.

By stakeholder consensus as further defined by the GDC, the following therapies were excluded: acupuncture, surgical procedures, invasive analgesic procedures including nerve blocks, neuro-ablative procedures, epidural blocks, facet and intramuscular injections, botulinum toxin, systematic psychological interventions such as cognitive or behavior therapies for anxiety or depression, and over-the-counter or prescription drugs.

Upon further consideration The CCA and CFCREAB stakeholders further deemed that cognitive behavior therapy (CBT) may be considered by chiropractors in the context of multidisciplinary treatment. Also, regarding CBTs, the GDC deemed that it is within the scope of chiropractic to address the client's fears and concerns regarding their recovery. As such these treatments were included in the review.

The search strategy was designed to retrieve all publications excluding editorials and letters to the editor. Results were limited to adult subjects ($\geqslant$ 18 years of age). Manual searches of reference lists of review articles and treatment studies were also completed. An exception to this approach involved citing recently published work from The Bone and Joint Decade 2000–2010 Neck Pain Task Force [27] (BJD TF). The work of the BJD TF was published during the preparation of this manuscript and the GDC considered it important to consult this work where appropriate for the clinical management of WAD.

3.3. *Selection for relevance* (*Steps 4 & 5*)

Literature results were entered into a searchable database, and relevant publications were retrieved as hard copies and evaluated. In the first stage of the review (1a review), articles were selected based on the screening of abstracts and titles and in review 1b the full text was screened for consistency with the operational definitions for chiropractic treatment, neck, adult and WAD. Two independent reviewers used these criteria and where necessary, uncertainties were resolved by a

Table 2
The Utilization of Oxford Centre for Evidence-Based Medicine (OCEBM) Levels of Evidence

The categorization below is adapted from OCEBM levels of evidence. Documents at the referenced web-site were used to discriminate between good and poor quality studies of the same design.		The interpretation (below) of the meaning of levels of evidence (left column) is the opinion of the GDC, based on the OCEBM recommendation grading system.		
Study type	Evidence level	Study results are . . .	You interpret results. . .	Clinical meaning & recommendation grade
Systematic review of randomized control trials (RCT) with homogeneity	1a	almost certain	objectively	Recommendations directly supported by evidence are very likely reliable and valid.
Individual RCT (with narrow Confidence Interval)	1b			
All or none	1c			
Systematic review of cohort studies with homogeneity	2a	strongly suggestive	objectively	Recommendations directly supported by evidence are likely reliable and valid.
Individual cohort study, low quality RCT	2b			
Outcomes research, ecological studies	2c			
Systematic review of case-control studies (with homogeneity)	3a			
Individual case-control study	3b			
Case-series, poor quality cohort and case-control studies	4	suggestive	objectively	Recommendations directly supported by evidence may be reliable and valid.
Expert opinion with explicit critical appraisal, and based on one of physiology, bench research, first principles	5	inconclusive	objectively	Reliability and validity of recommendations uncertain.
Studies of Levels 1–4 that are inconclusive due to flaws in their design or analytic logic, but that present authored conclusions				
Other (e.g., literature review, CPG, reviews of reviews)				
	subjective extrapolation from Levels 1 to 5			

third reviewer. Articles were selected for further analysis if the study population included clients with WAD 1 to 4, and at least one subgroup of clients received care relevant to chiropractic practice.

Next, studies found by the first literature search were tagged with tracking numbers, and then 2 evidence extractors were allocated alternately numbered studies. Other review papers were considered relevant to this research only if they described systematic reviews of treatment literature for WAD. Systematic reviews for general neck pain, mechanical neck pain not attributed to whiplash, or neck pain of unknown etiology were excluded. Non-systematic reviews or reviews that confounded outcome or treatment data from WAD and non-WAD patients were excluded.

3.4. Quality assessment (*Step 6*)

A quality assessment of the final extracted articles was conducted by an external review team. Papers that failed to distinguish treatments, outcomes, time since injury, or data from WAD versus non-WAD clients were excluded. First, the evidence extractors together used a Table adapted from The Oxford Centre for Evidence-based Medicine (OCEBM) levels of evidence [2,49] to categorize the remaining 27 studies into 5 Levels of evidence see Table 2. Where necessary, disagreements were resolved with the participation of a third evidence extractor.

Next, given that the evidence included treatments provided by a range of health care providers the evidence extractors conducted a source evidence [24,25], qualitative review process to interpret the quality and the clinical relevance of the treatment and outcomes for chiropractic practice. This process involved a review team comprised of a health care professional and two expert chiropractic contributors who conducted the analysis of source evidence. This team qualitatively reviewed each study to assess the methodological quality of the level of evidence supporting the main outcomes of the studies and evidence benefit of health outcomes for chiropractic. The team openly discussed the quali-

ty of the studies to achieve group consensus on rating of the level of evidence of the study findings, reflecting the confidence with which the reported data could support clinically relevant conclusions. The levels of evidence (using the OCEBM see Table 2) reflecting the confidence with which the reported data could support clinically relevant conclusions are listed in column 5 of Tables 3, 4, 5. A different three-panel clinical expert review team reviewed the findings of the extractors with minor revisions.

3.5. Evidence synthesis (*Steps 7 & 8*)

The heterogeneity of the interventions posed a considerable challenge for data synthesis. In addition, the quality of evidence did not support the statistical pooling of outcomes data. Hence, the advancement of the review required additional deliberation among the GDC, the CPG TF and contributor teams to decide on the approach to evidence analysis and synthesis. A decision was made to use a qualitative approach to conduct best evidence synthesis using the results of the source evidence [24,25] quality ratings.

3.5.1. Criteria for best evidence synthesis

Slavin's approach to best evidence [64] involves establishing a process and criteria for evaluating the quality of the evidence supporting health outcomes, based upon the *quantity of evidence* and the *consistency of findings*. The processes for establishing the quality ratings included a systematic method of extrapolation (achieved in Steps 1–6) followed by a systematic analysis of source evidence [24].

3.5.1.1. Quantity and consistency of evidence

The GDC established criteria for best evidence synthesis to answer the question 'Does chiropractic management of WAD clients have an effect on improving health status?' The criteria of two or more studies of the same quality (L4 equivalent to a low level) or greater were sufficient to establish a minimal level baseline for conducting best evidence synthesis. In this process of the review, quality ratings in column 5 of Tables 3–5 were used to identify studies of the same quality (L4) or greater that consistently converged on similar outcomes across 2 or more studies. Likewise findings were reviewed for consistency within the categories of treatments to identify the minimum level of consistency for establishing a baseline of best evidence synthesis. The GDC determined the minimum level to be two or more studies rated L4 or greater. The GDC provided expert consensus recommendations if suggestions for practice were warranted across studies when findings were L5 or only one study was rated as L4. Following the review of the evidence the GDC provided recommendations for clinical practice or research.

3.6. Interpret knowledge and evidence for advancing the management of WAD

In uncovering the overwhelming diversity in the treatment approaches presented in the literature, the expert contributor team and the GDC identified the need for a framework to organize current and future findings consistent with clinical processes used in the management of WAD. Additional review and interpretation of the 27 articles and related literature relevant to the chiropractic management of WAD was conducted by the GDC to identify ways to address the knowledge gaps. The expert review contributor team and GDC reflected on the WAD literature, the current baseline and gaps of evidence identified in the systematic review, and what factors contributed to the gaps in the research processes in studies, as well as, inconsistencies across studies in the literature. Through this appraisal process the GDC constructed a framework for use in the management of WAD and for future clinical research titled the WAD-Plus Model (see description of WAD-Plus Model in section 4.6).

4. Findings and recommendations

4.1. Literature searches

Literature searches found 1,155 citations. Eighty-nine treatment articles were selected for relevance, and 24 studies were analyzed in detail [5–7,10,16,18–20, 22,28,29,42,44,51–53,56,59,61,65,66,70,75,77]. Three articles [36,50,71] identified by the BJD TF were more recent than this guide's literature search and underwent a quality assessment and source evidence evaluation bringing detailed study extractions to 27.

Data were extracted for synthesis from the 27 studies. Studies investigating treatment interventions were categorized into three groups based on WAD clinical presentation and time since injury: acute (Table 3), subacute (Table 4) and chronic (Table 5). The majority of the 27 studies reported findings relevant to one or more WAD grades. The primary health status outcomes reported in the treatment outcomes studies for WAD were cROM and pain. Additional health outcomes

Table 3

Literature summary and quality ratings of the evidence for interventions for acute whiplash

Study	Interventions studied	Results on health outcome(s)	GDC recommends	Quality rating*
Borchgrevink et al., 1998	Maintain nADLs vs. Rest, sick leave, daytime collar for 14 days	At 6 months 1° analyses: – Pain factor/composite (improved; no group differences) Other analyses: – Attention Factors (Y; maintain ADLs) – Tinnitus (no group differences) – Pain distribution (Y; maintain ADLs) – Pain during ADL (Y; maintain ADLs) – Mobility (no group differences) – VAS (Y; maintain ADLs) – Neck stiffness (Y; maintain ADLs) – Sick Leave (no group differences) – Self-ratings (no group differences)	Maintain nADL	L4
Kongsted et al., 2007	Maintain nADLs vs. Daytime collar for 14 days vs. Active mobilization program	At 1 year 1° analyses: Both groups improved: – Headache and neck pain intensity (no group differences) 2° analyses (no group differences reported): – Change in headache and neck pain – Medication use – SF-36 – Neck mobility	Maintain nADLs	L5
Oliveira et al., 2006	Educational video, information/ instruction vs. Information/instruction	At 1, 3 and 6 months: 1° analyses: – Pain (Y; video) Other analyses: – Patient satisfaction (Y; video) – Life change (Y; video) – Workdays missed (Y; video)	Educational video or in-person information about cervical strain and the role of exercise and relaxation	L5
Ferrari et al., 2005	Emergency dept. usual care plus educational pamphlet vs. Emergency dept. usual care	At 2 weeks and 3 months (no group differences): – Recovery outcomes – Resource use – Work status – Litigation	Recommendation against using a one-time information tool unless cost and burden of use are negligible	L5

Table 3, continued

Study	Interventions studied	Results on health outcome(s)	GDC recommends	Quality rating*
Brison et al., 2005	Emergency dept. usual care plus educational video vs. Emergency dept. usual care alone	At 24 weeks 1° analyses: – WAD symptoms (no group differences) 2° analyses: – Change in pain scores (Y; video)	Educational video or in-person information about cervical strain and the role of exercise and relaxation	L5
Bonk et al., 2000	Multimodal, physiotherapy vs. Daytime collar for 3 weeks, rest vs. Uninjured controls	At 3, 6 and 12 weeks:: – Neck pain (Y; multimodal) – Neck stiffness (Y; multimodal) – Headache (Y; multimodal) – Shoulder pain (Y; multimodal) – Arm pain (Y; multimodal) – cROM (Y; multimodal at week 3 only)	Multimodal, active treatment	L4
Schnabel et al., 2004	Collar for 1 week vs. Exercise therapy (2–5 visits in first week)	At 6 weeks: 1° analyses: – Pain and disability (Y; exercise group) 2° analyses: – Headache (Y; exercise group) – Shoulder pain (Y; exercise group) – Back pain (no group differences) – Limb pain (no group differences) – Limb paresthesia (no group differences) – Visual disturbances (no group differences) – Tinnitus (no group differences) – Dizziness (no group differences)	A medium course of unsupervised c-ROM exercise	L5
Crawford et al., 2004	Collar for 3 weeks, then exercise vs. Brief collar use, then exercise	At 3, 12 and 52 weeks: – Pain (no group differences) – nADLs (no group differences) – cROM (no group differences) – Work status (Y; exercise group)	Early unsupervised cROM-exercise	L4
Gennis et al., 1996	Rest, analgesics, Collar for 2 weeks vs. No collar	At 6 to 10 weeks: Both groups improved – Pain (no group differences)	No recommendation on which treatment to choose	L5

Table 3, continued

Study	Interventions studied	Results on health outcome(s)	GDC recommends	Quality rating*
McKinney et al., 1989; McKinney, 1989	Collar, then: Rest, analgesics vs. Manipulative physiotherapy vs. Advice, exercise	At 1 and 2 months: – Neck movement (Y; physiotherapy; exercise) – Pain (Y; physiotherapy; exercise) After 2 years: – Recovery (Y; Advice, exercise group only)	Consider manipulative physiotherapy or advice, unsupervised exercise whichever will least exacerbate chronicity factors	L4
Mealy et al., 1986	Collar, then gradual mobilization vs. Active treatment: Maitland mobilization, unsupervised cROM exercise	At 4 and 8 weeks: – Pain (Y; active treatment) – cROM (Y; active treatment)	Early mobilization-based treatment (Maitland, unsupervised exercise)	L4
Hendriks et al., 1996	Multimodal treatment (supervised, and unsupervised cROM exercise thermotherapy, information) plus ultra-reiz electrotherapy vs. Above multimodal treatment without ultra-reiz electrotherapy	At 15 min post-treatment and 6 weeks: – Pain (Y; multimode, electrotherapy) – cROM (mixed findings)	Short course of multimodal treatment with ultra-reiz electrotherapy for pain	L5
Osterbauer et al., 1992	Mostly activator-assisted manipulation, optional interferential current	At 6 weeks and 1year: – Pain (Y) – cROM (Y)	Activator-assisted manipulation and interferential current	L4
Pennie et al., 1990	Active treatment: Initial collar, information, traction, unsupervised exercise vs. Initial collar, collar for 2 weeks and rest followed by unsupervised exercise	At 6, 8 weeks and 5 month: – Pain (no group difference) – CROM (no group differences) – Work status (no group differences)	No recommendation for or against study interventions	L5
Rosenfeld et al., 2003	Active treatment: Unsupervised and supervised cROM-exercise, information, McKenzie mobilization vs. Unsupervised cROM-exercise, information, rest, instruction	At 6 months and 3 years: – Pain (Y; active treatment) – cROM (no group differences) – Sick leave (Y; active treatment)	Unsupervised and supervised cROM exercise, information and McKenzie mobilization for pain	L5

1°Primary outcome measure.
2°Secondary outcome measure(s).
*As assessed by literature extractors and reviewed by GDC. The quality rating of the evidence on health outcomes for each study utilized the GDC adapted OCEBM scale (Table 2).
Y: Yes significant improvement reported for outcome.
No group differences or "N": No statistically significant differences reported across treatment groups.
nADLs: normal activities of daily living.
cROM: cervical range of motion.
CBT: cognitive behavioural therapy.

Table 4

Literature summary and quality ratings of the evidence for interventions for subacute whiplash

Study	Interventions studied	Outcomes	GDC recommends	Quality rating*
Provinciali et al., 1996	Multimodal treatment (cervical massage or mobilization, relaxation, posture instruction, eye fixation exercises, and psychological support) vs. Electrotherapy, sonic modalities	At 6 months: – cROM (no group differences) – Pain (Y; multimodal treatment) – Self-rating scale (Y; multimodal treatment) – Work status (Y; multimodal treatment)	Use short course of multimodal treatment	L4
Scholten-Peters et al., 2006	GP care: (education, advice promoting nADL and collar avoidance, graded activity, co-interventions permitted) vs. Physiotherapy: (education, advice, graded activity, supervised exercise, manual therapy)	At 12 and 52 weeks: 1° outcomes: – Neck pain intensity (no group differences) – Headache intensity (no group differences) – Work status (Y; at 52 weeks for GP care) 2° outcomes: – Functional recovery (Y; at 52 weeks GP care) – cROM (Y; at 12 weeks physiotherapy) – Kinesiophobia (no group differences) – Coping (Y; at 52 weeks GP care) – General health (no group differences) – SF-36 subscales (Y; at 52 weeks GP care)	Add supervised exercise and manual therapy in the long term only if cROM outcomes are a priority.	L5
Söderlund et al., 2000	Unsupervised cROM-exercise, posture and collar avoidance instruction with unsupervised kinaesthetic exercise vs. Unsupervised cROM-exercise, posture and collar avoidance instruction without kinaesthetic exercise	At 3 and 6 months: Both groups improved – Pain Disability Index (no group differences) – Pain Intensity (no group differences) – Self Efficacy (no group differences) – Coping – ability to decrease pain (Y; at 6 months kinaesthetic group) – cROM (no group differences) – Kinaesthetic ability (no group differences) – Posture (no group differences)	Unsupervised cROM exercise and posture and collar avoidance instruction	L4

Table 4, continued

Study	Interventions studied	Outcomes	GDC recommends	Quality rating*
Bunketorp et al., 2006	Supervised exercise, unsupervised low-intensity aerobic exercise, comprehensive CBT vs. Unsupervised exercise, unsupervised low-intensity aerobic exercise, comprehensive CBT	At 3 and 9 months: 1° outcomes: – Self-efficacy (Y; at 3 months Supervised) – Kinesiophobia (Y; at 3 months Supervised) – Pain Disability index (Y; at 3 months Supervised) 2° outcomes: – Pain intensity (no group differences) – Sensory and affective dimensions (no group differences) – Tenderness (no group differences) – CROM (no group differences) – Strength (no group differences) – Absenteeism (no group differences)	Supervised exercise	L5 Primary outcomes L4 Secondary Outcomes
Fialka et al., 1989	Electrotherapy (interferential current) vs. No treatment	At 1 month: – Pain (no group differences) – Headache (Y; untreated)	If deemed necessary, electrotherapy for pain only.	L4

1°Primary outcome measure.
2°Secondary outcome measure(s).
*As assessed by literature extractors and reviewed by GDC. The quality rating of the evidence on health outcomes for each study utilized the GDC adapted OCEBM scale (Table 2).
Y: Yes significant improvement reported for outcome.
No group differences or "N": No statistically significant differences reported across treatment groups.
nADLs: normal activities of daily living.
cROM: cervical range of motion.
CBT: cognitive behavioural therapy.

Table 5

Literature summary and quality ratings of the evidence for interventions for chronic whiplash

Study	Interventions studied	Outcomes	GDC recommends	Quality rating*
Stewart et al., 2007	Instruction/advice plus exercise vs. Instruction/advice alone *Note:* Some subjects sought additional treatments outside of study	At 6 weeks and 12 months: 1° outcomes: – Pain intensity (Y; at 6 weeks, exercise) – Pain bothersomeness (Y; at 6 weeks, exercise) – Function (Y; at 6 weeks, exercise) 2° outcomes: – Disability (Y; at 6 weeks – QoL (Y; at 6 weeks) – Global perceived effect (Y; at 6 weeks, exercise) – Work status (no group differences)	Recommends against instruction/advice alone	L5
Sterner et al., 2001	Multimodal rehabilitation program (supervised cROM-exercise, comprehensive pain instruction) *Note:* Uncontrolled pre- and post-treatment design	Immediately after program and at 6 months: – Neck pain intensity (Y) – Upper back pain intensity (Y; at 6 months) – Pain other regions (N) – Beck depression index (N) – Pain inventory (N) – Coping (N) – Life satisfaction (N)	Recommends against a medium course of supervised cROM-exercise and pain instruction for pain and other objective outcomes.	L4
Heikkilä et al., 1998	Unsupervised exercise, comprehensive CBT *Note:* Uncontrolled pre- and post-treatment design	Immediately after program and at 2–3 years: – Coping (Y) – Life satisfaction (Y) – Absenteeism (Y; increased)	Exercise with CBT components	L4
Vendrig et al., 2000	Supervised and unsupervised exercise, CBT component *Note:* Uncontrolled pre- and post-treatment design	Immediately after program and at 6 months: – Pain (Y) – Self-reported disability (Y) – Somatic complaints (Y) – Lassitude (Y) – Depression (Y) – Mental dullness (Y) – Cognitive complaints (Y)	Instruction and exercise with CBT components	L4

Table 5, continued

Study	Interventions studied	Outcomes	GDC recommends	Quality rating*
Fitz-Ritson, 1995	Unsupervised 4-level exercise, chiropractic care vs. unsupervised phasic exercises, chiropractic care	At 8 weeks: – Disability (Y)	Add unsupervised phasic exercise to treatment regimen to improve cervical disability	L4
Söderlund et al., 2001	Unsupervised cROM- and stabilizing-strength-exercise, information, relaxation, TENS, acupuncture, heat plus CBT components vs. Above modalities with no CBT components	Immediately after program and at 3 months: – Disability (no group differences) – Pain intensity (no group differences) – cROM (no group differences) – Posture (no group differences) – Global treatment effect (Y; CBT group) *Note*: Subjects with high vs. low self-efficacy demonstrated better coping outcomes	Consider CBT components through multidisciplinary management for global pain. nADLs, and compliance with advice are concerns.	L4
Woodward et al., 1996	HVLA manipulation, proprioceptive neuromuscular facilitation, and cryotherapy. *Note*: retrospective case analysis	– Symptom improvement (Y)	Further research on chiropractic treatments is warranted.	L5

1°Primary outcome measure.
2°Secondary outcome measure(s).
*As assessed by literature extractors and reviewed by GDC. The quality rating of the evidence on health outcomes for each study utilized the GDC adapted OCEBM scale (Table 2).
Y: Yes significant improvement reported for outcome.
No group differences or "N": No statistically significant differences reported across treatment groups.
nADLs: normal activities of daily living.
cROM: cervical range of motion.
CBT: cognitive behavioural therapy.

used less frequently were coping resources, life satisfaction, absenteeism, disability, somatic complaints, lassitude, depression, mental dullness, cognitive complaint, headache, self-efficacy, posture kinesthetic sensibility, kinesiophobia, strength and tenderness. In this review, no controlled studies were found in the published literature assessing HVLA manipulation for the treatment of WAD in adults.

4.2. Review of the evidence

Fifteen studies are in acute WAD [5,6,16,18,22, 29,36,42–44,50–52,56,59], 0–7 days since injury (Table 3). Note two papers by McKinney [42,43] cover one study in acute WAD and are therefore counted only once. Five studies are in subacute WAD [10, 19,53,61,66], 1 week to 3 months since injury (Table 4). Seven studies are in chronic WAD [20,28,65,70,71, 75,77], defined as persistent pain and symptoms more that 3 months since injury (Table 5). The review of the evidence is organized below by acute, subacute and chronic (WAD) categories. Each category begins with a summary of the best evidence where evidence across studies consistently converged on the same health outcomes and recommendations for practice are provided.

Low quality evidence (4 controlled studies [5,16,42–44] satisfying best evidence synthesis criteria, McKinney studies count as one) suggests early mobilization, information/instruction, unsupervised and supervised c-ROM exercise within multimodal treatment regimens improve pain and cROM in acute WAD. Low quality evidence (2 controlled studies [53,66] satisfying best evidence synthesis criteria) suggests multimodal treatment: posture instruction, mobilization, massage and c-ROM exercise; improves pain in subacute WAD. In chronic WAD, low quality evidence (2 controlled studies and 3 cohort studies satisfying best evidence synthesis criteria) [20,28,65,70,75] suggests that unsupervised and supervised c-ROM-exercise and multidisciplinary care (e.g. chiropractic plus psychological treatments such as CBT) support improved health outcomes including pain and related psychosocial symptoms.

In the original papers of this review, side effects of various treatment modalities were not reported in detail by investigators. Consequently, risk profile(s) are not discussed in this review.

4.3. Treating clients with acute WAD

The literature provides sufficient evidence to establish a baseline (two or more studies L4 or higher) to support chiropractic care of acute WAD. Evidence across treatment studies (Table 3) suggests a pattern that pain and cROM benefit from combinations of the following modalities: early mobilization, information/instruction, unsupervised and supervised cROM-exercise within multimodal treatment regimens [5,16, 42–44].

Exercise protocols varied across published studies. In one prospective, randomized, controlled study of activity versus collar [5], clients enrolled within 3 days of an accident. For the first week, treatment was delivered with the client in a supine position: 3 sessions of 10 min of ice applied to the neck muscles, and then passive mobilization of the neck through all tolerable cROM, followed by active mobilization, then supervised strengthening and isometric exercises of the neck muscles. In the second week, 2 sessions of the same regimen were provided, but now in a seated position. In the third week, 2 sessions of unsupervised interscapular muscle strengthening exercises were provided and information about maintaining normal neck posture. The study demonstrated that active therapy compared to collar and rest resulted in significantly better rates of recovery.

McKinney et al. [42] studied 170 clients with undefined WAD, randomized to 1 of 3 treatment groups within 72 hours of a whiplash injury. Prior to randomization, all clients received cervical spine radiology, cROM and pain assessments, soft cervical collar, and analgesia (1000 mg Co-dydramol QID). Treatment group 1 (rest and analgesia) included a one-time general information session on self-mobilization after a rest period of 10 to 14 days. Group 2 (active outpatient physiotherapy) included physiotherapy over 6 weeks with three 40-minute sessions per week of individualized therapy using the “full gamut” of known methods (totaling 10 hours: hot and cold applications, short-wave diathermy, hydrotherapy, traction, and active and passive repetitive movements [as per McKenzie and Maitland]), and defined unsupervised cROM-exercises. Group 3 (mobilization advice) included one-time, 30-minute verbal and written (encouraging) instruction about posture correction, muscle relaxation, unsupervised cROM-exercises that were also demonstrated, and the use of analgesia, heat and avoiding reliance on collar use. Outpatient physiotherapy (Group 2) exhibited similar outcomes on cervical pain and cROM at 1 and 2 months as Group 3 (mobilization advice). Both groups demonstrated significantly better outcomes on pain severity scores than initial rest followed by self-mobilization (Group 1). In a 2-year

follow-up of the same clients [43], longer-term outcomes across the 3 treatment groups were compared. Unsupervised cROM-exercise (Group 3) demonstrated the most favorable outcomes by 2 years. The percentage of clients with persistent symptoms was 46% for rest and self-mobilization, 44% for normal hospital physiotherapy, 23% for unsupervised cROM-exercise (Group 3), and 41% among a group of subjects that dropped out of the study. For the dropouts and all clients but the rest and self-mobilization group, the duration of collar wearing differentiated those having persistent symptoms at 2 years from those without symptoms. This suggests that collar slowed recovery and spurred chronicity in some cases.

Mealy et al. [44] studied 61 clients with undefined WAD randomized to one of two groups: (1) Collar: soft cervical collar and rest for 2 weeks followed by collar and gradual mobilization, (2) Active Treatment: ice in the first 24 hours and then an unsupervised cROM-exercise combination (neck mobilization [Maitland technique] with heat applied after each treatment), daily unsupervised cROM-exercises within the limits of pain every waking hour at home. All clients took oral analgesics as needed. The Active Treatment group showed improved pain and movement at both 4 and 8 weeks. The degree of improvement seen in the Active Treatment group compared with the Collar group was significantly greater for both cROM and pain intensity.

In an additional study assessing collar, Crawford et al. [16]. studied 108 clients with WAD-1 to -2 who received a "standard" soft cervical collar and nonsteroidal anti-inflammatory drugs (NSAIDs) at first presentation. Within a few days, clients were randomized to either a soft cervical collar (average use 26-days), or treatment of unsupervised cROM-exercise with instructions to mobilize without the collar as soon as possible (average collar use was 6-days before mobilizing). At 3 weeks, the collar group was switched to the exercise treatment. No differences were found between groups for pain, range of motion, or activities of daily living at 3-, 12- and 52-week follow-up visits. The collar group took significantly longer to return to work. Treatment with soft collar had no obvious benefit in terms of functional recovery of WAD and was associated with a prolonged time off work.

Evidence suggests that clients with acute WAD may benefit from combinations of the following modalities: early mobilization, unsupervised and supervised cROM-exercise, and instruction. Exercise protocols varied in the literature. For this reason, chiropractors should base prescribed exercise regimens on clinical experience and a client's specific situation. The GDC consensus is that chiropractors should use a balance of passive and active care in relation to each client's clinical presentation and the treatment regime should become more active with time. Resumption of normal activities of daily living should be encouraged. Evidence does not currently support the use of collar to improve health outcomes.

4.4. Treating clients with subacute WAD

Two L4 studies provide corroborating evidence to support the use of multiple modalities [53,66] to achieve improved pain outcomes in subacute WAD (Table 4). Provinciali et al. [53] studied 60 clients with WAD-1 or WAD-2 an average of 30 days after injury. One treatment group received multimodal treatment (massage or mobilization, training for relaxation [diaphragmatic breathing in supine position] and posture [based on "Neck school" principles], psychological support, and eye fixation exercises). The second group received iontophoresis with calcium chloride and an electrotherapy treatment of transcutaneous electrical nerve stimulation (TENS), pulsed electromagnetic field therapy (PEMF, as per Foley-Nolan), and "frequent" ultrasound. Both groups exhibited improvement in cROM and pain. Compared with the electrotherapy group, the multimodal group returned to work sooner within the 6-month follow-up period, showed better self-rated improvement at 15 days (the end of treatment) and 6 months, and reported less pain at 15 days, 1 and 6 months. There were no differences between groups for cROM at 15 days, 1 or 6 months.

In an additional study, mobilization and prognostic factors were studied in 59 clients with WAD-1 to -3 on average 20 days after injury [66]. Prior to randomization, all clients were instructed to resume normal activities of daily living (nADL) as soon as possible. Analgesics were permitted. Two home exercise programs were compared: one group was prescribed at least 3-times daily unsupervised cROM-exercise that included pacing activities and cROM to the limit of pain, and was told to keep their neck from getting cold, and about posture and lifting. The second group received all of the first group's interventions, as well as a prescription for 3-times daily unsupervised kinesthetic exercise. At 3 and 6 months, both groups showed similar improvements in disability, coping strategies, pain intensity, cervical posture, cROM, and cervical kinesthetic sensibility.

Literature suggests that clients with subacute WAD may benefit from multiple modalities to improve pain: posture instruction, mobilization, massage and c-ROM exercise. When choosing two or more outcome equivalent treatments, choose the one that is least likely to contribute to a client's propensity for chronic WAD. The treatment that is less complex and less costly is recommended if both treatments suggest similar impact on chronicity. Exercise protocols varied in the literature. For this reason, chiropractors should base prescribed exercise regimens on clinical experience and on a client's specific situation. GDC consensus is that future investigations are needed to evaluate the effect of treatments in subacute WAD and that chiropractors should use a balance of passive and active care in relation to each client's clinical presentation and the treatment regime should become increasingly more active with time.

4.5. Treating clients with chronic WAD

Studies in the chronic category suggest that there are benefits across a range of health outcomes [20,28,65, 70,75]. For instance, health outcomes examined include pain, disability, cROM, posture, coping resources and life satisfaction.

Fitz-Ritson [20] evaluated whether "phasic" exercises benefit chronic whiplash clients. In a randomized controlled study, one group of subjects ($n = 15$) was prescribed standard unsupervised exercises (stretching/isometric/isokinetic) and chiropractic therapy. In a second group ($n = 15$), subjects completed phasic exercises consisting of rapid eye-head-neck-arm movements and chiropractic therapy. Both groups exercised for a minimum of 4 times per week for 8 weeks. At the end of treatment, both groups showed improved neck disability index scores, with the unsupervised phasic exercise group showing greater improvement.

Heikkilä et al. [28] studied the effects of multidisciplinary rehabilitation over 6 weeks with 40 chronic whiplash clients. Treatment included various unsupervised exercises and counseling using cognitive behavioral therapy methods. Approximately half of the clients experienced improved coping and life satisfaction 2 years after treatment. One caveat, however, is that clients also reported significantly more sick-leave absenteeism 1 and 2 years after treatment compared to baseline.

Söderlund and Lindberg [65] studied 33 clients with chronic WAD-1 to -3. Clients were randomized to 2 groups that each received a maximum of 12 treatments over an undefined period. In addition to usual physiotherapy care, the experimental group received endurance and coordination cROM-exercises, and a median of 11 treatments utilizing cognitive behavioral therapy (CBT) principles. CBT treatment first included "functional behavioral analysis" that identified problem behaviors and treatment goals, information about skills of self-efficacy and coping with pain, training about relaxation, and "re-education" about posture. CBT also addressed the integration of acquired skills into nADL. Post-treatment and at 3 months, there was no difference between groups in pain intensity, disability, cROM, or cervical-spine coordination. Using subjective global questions, the CBT group reported significantly less pain than the control group immediately after treatment and 3 months later. At 3 months after treatment, the CBT group also reported greater ability to perform nADL and greater compliance with taught strategies.

Sterner et al. [70] studied 88 WAD-1 to -3 clients with symptoms lasting 3 months to 1 year, and were allocated to receive treatment three times weekly (over 5 weeks) or twice-weekly (over 6 weeks). The treatment included group meetings at the client's workplace, ergonomics, body awareness therapy, relaxation, physical activity including hydrotherapy, and instruction about pain, pharmacology, stress, and the psychological consequences of pain. Supervised cROM-exercises facilitating neck activity and normal movement patterns were included in the ergonomic, physical activity and body awareness components. Clients reported satisfaction with the therapy regimen 6 months after treatment with diminished neck and upper back pain. No differences were found, however, for functional or psychological outcomes.

Vendrig et al. [75] assessed 26 WAD-1 to -2 clients with symptoms lasting at least 6 months, who received 4 weeks of a daily multimodal treatment focused on behavior modification. Treatment addressed pain-eliciting behavior, reduced collar use, and included exercise, assistance returning to work, and exploration of subjects' beliefs regarding symptoms and disability. Pharmacotherapy was permitted; 42% of clients used analgesics at 6 months. Improvements in pain intensity, disability, and the Minnesota Multi-phasic Personality Inventory (MMPI) scales for somatic complaints, lassitude, depression, mental dullness, and cognitive complaints were seen at the end of treatment and at 6 months follow-up.

Best evidence synthesis across these studies in the chronic category demonstrates improved health outcomes for pain and/or disability depending upon a

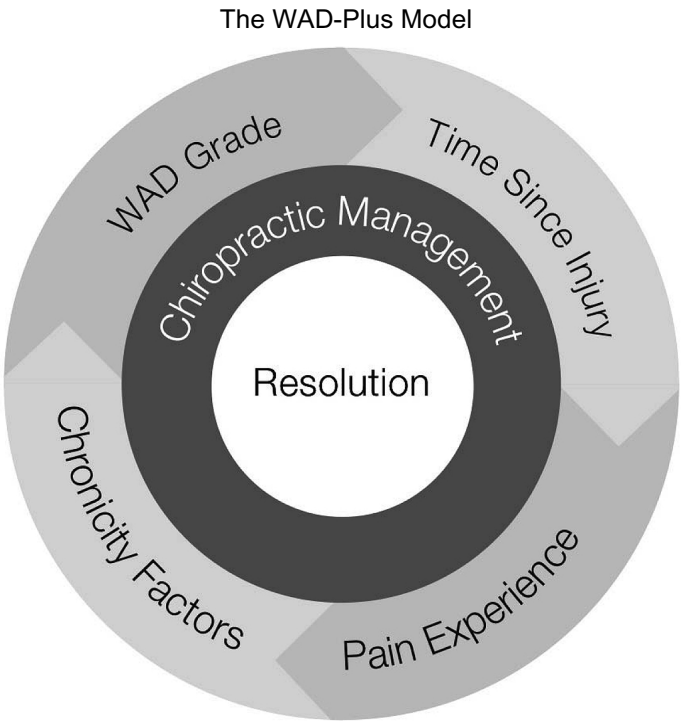


Fig. 1. The WAD-Plus model takes into consideration (1) WAD grade (2) time since injury (3) pain experience and (4) chronicity factors.

combination of unsupervised exercise [20,28], supervised exercise [65,75] and cognitive behavioral therapy (CBT) [28,65,75] (Table 5). Overall, the treatment modalities in the management of chronic WAD are more likely to improve health outcomes if the client is actively involved in care and if the modalities are interactive, that is they are characterized by active involvement and responsibilities of both the client and the practitioner, and if they are multidisciplinary.

Evidence suggests that clients with chronic WAD can benefit from combinations of the following modalities: unsupervised and supervised cROM-exercise and psychological counseling, such as CBT. The GDC consensus suggests that multidisciplinary care (e.g., chiropractic plus CBT) supports improved health outcomes. The GDC consensus is to balance passive and active care in relation to each client's clinical presentation.

4.6. Advancing the management of WAD through The WAD-Plus Model

The evidence review revealed methodological heterogeneity, diversity in the treatment approaches and knowledge gaps for the management of WAD. The baseline of evidence for chiropractic treatments of WAD is for the most part low or based on expert consensus. This paper supports findings of other reviews in that active treatments over passive produce better results [31,76]. Similarly, the evidence in other reviews suggests that cervical stretching and strengthening exercises may be effective for the treatment of acute and possibly chronic whiplash [36,58]. However, there is limited evidence of benefit for electrotherapies in WAD [37].

Gaps in this review include the lack of studies on HVLA, the absence of reporting of adverse events in studies, a lack of consistency in the reporting on study subjects, WAD grades, health outcomes, time since injury, lack of common terms and definitions for a short, medium or long course of treatment and the health outcomes across time. These inconsistencies suggest that there is a need for a framework that amalgamates four dimensions of care important for the management of WAD: knowledge of WAD grade, time since injury, pain experience and chronicity. Thus, the GDC posits that the *WAD-Plus Model* (Fig. 1) be used to improve consistency in clinical management of WAD and in turn be used in future intervention studies of WAD.

The WAD-Plus Model refers to the assessment of WAD grade and 3 other important dimensions relevant to client care: time since injury, pain experience and chronicity factors (Fig. 1). As a model, it offers

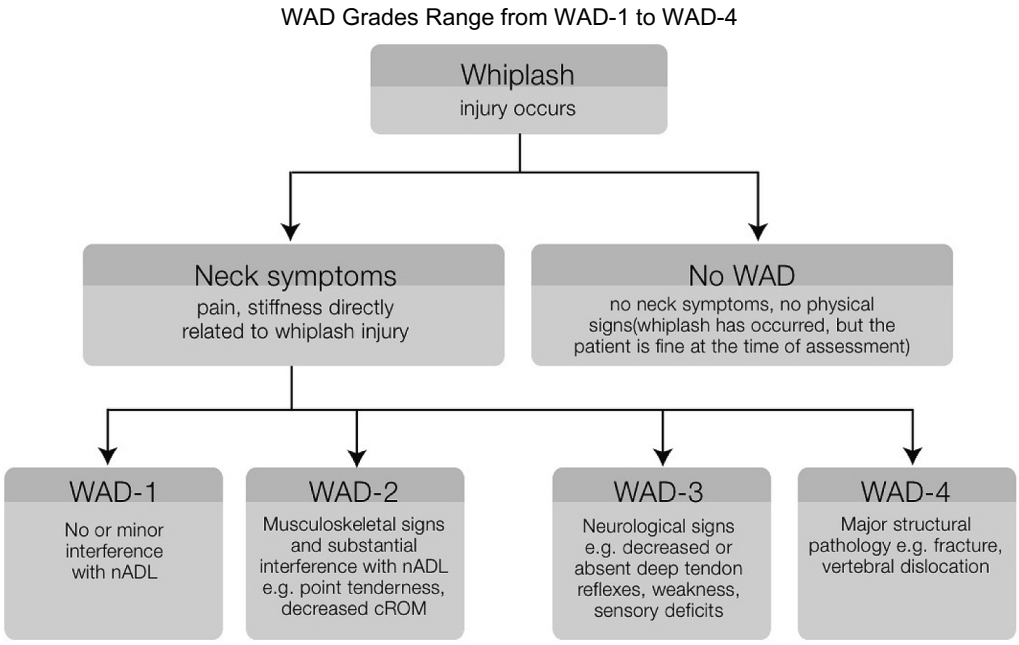
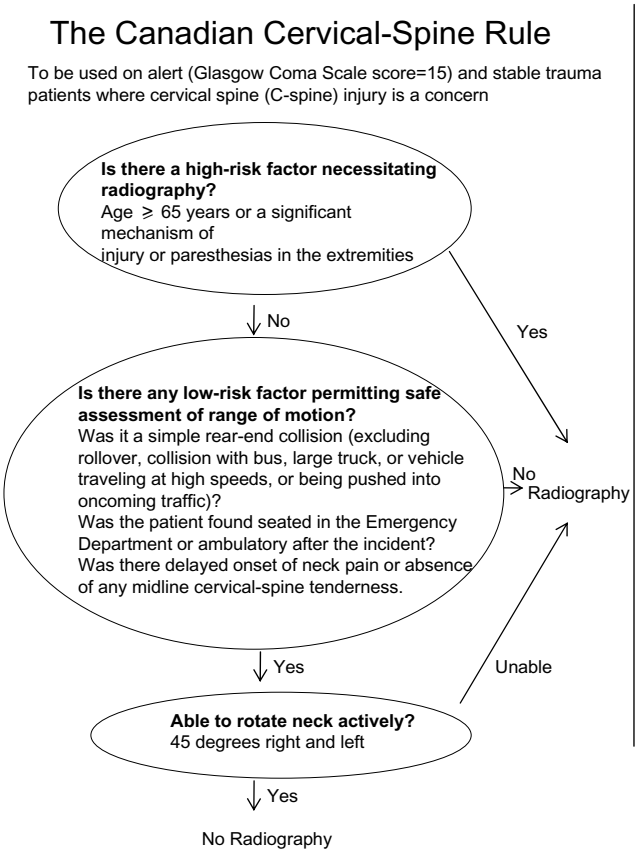


Fig. 2. Adapted from the work of The Quebec Task Force [11] and BJD TF [27] WAD grades range from WAD-1 to WAD-4 with all symptoms directly related to whiplash injury. The least serious, WAD-1 encompasses symptoms of neck stiffness or pain. WAD-2 includes symptoms of neck pain, stiffness or tenderness, with musculoskeletal signs (point tenderness, decreased cROM and symptoms substantially interfere with nADL). WAD-3 includes neck pain, decreased or absent deep tendon reflexes, weakness, sensory deficits or other neurological signs. WAD-4 is determined to be the most serious and when clients seek care in the acute or subacute phase of injury with unhealed fractures, unstable healed fractures or increasing neurological symptoms, immediate referral to the appropriate professional is necessary. Clients with chronic WAD-4 with stable healed fractures and without neurological signs can be assessed for chiropractic treatment.

a multipurpose structure: 1) to guide the mapping of evidence-based and expert consensus information consistent with the clinical assessment process; 2) to provide a conceptual model to support the future development of relevant treatment algorithms illustrating the practice dimensions used in WAD interventions; and 3) to provide a basis for future research studies. The relevant literature from the review supporting the development of the WAD-Plus Model and its dimensions are elaborated. In this section, GDC recommendations for chiropractic practice consistent with the dimensions in the WAD-Plus Model are put forward. While these recommendations for the use of WAD-Plus Model are specific to chiropractic management, other disciplines are encouraged to use these dimensions to support interdisciplinary approaches to the care and management of WAD. The GDC recommends that all four dimensions of the WAD-Plus Model should be considered as part of WAD care.

4.6.1. WAD Grade

Whiplash injury and the resulting signs and symptoms of WAD are delineated by WAD grades 1 through 4 (Fig. 2). The following definitions are an evolution from the current literature and documents that have shaped WAD grades [26,68]. A client's exposure to the intensity of a whiplash-provoking accident is reflected in the resulting WAD grade with a higher grade representing greater symptom burden. The least serious, WAD-1, encompasses symptoms of neck stiffness or pain with no or minor interference with nADL. WAD-2 includes symptoms of neck pain, stiffness or tenderness; musculoskeletal signs (decreased cROM and point tenderness); and the symptoms substantially interfere with nADL. Most clients with WAD present with WAD-2 [68]. WAD-3 includes neck pain, decreased or absent deep tendon reflexes, weakness, sensory deficits or other neurological signs. WAD-4 is determined to be the most serious and when clients seek care in the acute or subacute phase of injury with unhealed fractures, dislocations, unstable healed fractures or increasing neurological symptoms, immediate referral to the appropriate professionals is necessary. Clients with chronic WAD-4 with stable healed fractures and without neurological signs can be assessed for chiropractic treatment. WAD-0 has neither symptoms



The NEXUS Low Risk Criteria

C-spine imaging is recommended for patients with trauma unless they meet all of the following criteria:

Absence of posterior midline cervical-spine tenderness

Patients with midline posterior bony cervical-spine tenderness present with reports of pain on palpation of the posterior midline neck from the nuchal ridge to the prominence of the first thoracic vertebra, or if the patient expresses pain with direct palpation of any cervical spinous process.

No evidence of intoxication

Patients should be considered intoxicated if they have a recent history provided by the patient or an observer of intoxicating ingestion or evidence of intoxication on physical exam such as an odor of alcohol, slurred speech, ataxia, or any behavior indicative of intoxication. Patients may also be considered to be intoxicated if laboratory tests are positive for alcohol or drugs that affect the level of alertness.

A normal level of alertness and consciousness (baseline mental status)

Patients with an altered level of alertness may include any of the following: a Glasgow Coma Scale score of 14 or less; disorientation to person, place, time, or events; inability to recall three objects at five minutes; a delayed or inappropriate response to external stimuli; or alternative findings consistent with altered mental status.

Absence of focal neurological deficit

Patients with a focal neurological deficit is any focal neurological finding on motor or sensory examination.

Absence of any distracting injuries

Patients with a distracting injury is any condition that, in the examiner s judgment could be producing enough pain so as to distract the patient from another, particularly cervical, injury. Such injuries may include a long-bone fracture; a visceral injury; a significant laceration, degloving injury, or crush injury; large burns; or any other injury causing acute functional impairment.

*Adapted with permission from Stiell et al. [72]

Fig. 3.

nor requirement for treatment and is therefore excluded from the model.

The GDC consensus is that chiropractors conduct a focused examination to establish each client's WAD grade *prior* to treatment and during reevaluation. Chiropractors may use the Canadian Cervical Spine (C-Spine) Rule or the NEXUS low-risk criteria to screen low risk injuries and to rule out the need for further imaging of neck trauma in adult patients [72,73]. See Fig. 3. The chiropractor should consider if the current presentation of WAD is a resolving disorder of a more severe grade. At each reassessment, the chiropractor should consider if a reclassification to a greater WAD grade may result from the evolving nature of WAD or from a delayed onset of signs or symptoms.

4.6.2. Time since injury

Tissue is differently susceptible to interventions over time, and care must be tailored accordingly. Three well-accepted stages of soft tissue healing are inflammation, repair and remodeling [38]. Acute, inflamed soft tissue is swollen, erythematous and touch-sensitive. In a healthy person, injured tissue demonstrates an acute inflammatory response for several days. During this time, the client experiences increased blood flow as repair elements are delivered to the affected tissue and cellular debris is removed from it. Soft tissue then enters repair and remodeling phases lasting from weeks to months [38]. Each client heals at a different rate and tissue healing may be slower in a WAD client who is otherwise ill. An ill client who shows inflamed soft tissue for months should be treated with an *acute* clinical approach for that period. As a result, while time since injury is used to designate phases when tissue is differently susceptible to interventions, chiropractors are responsible for ensuring that a client is truly in a particular phase of healing. The GDC consensus is that the chiropractor should identify each client's phase

of healing prior to treatment (e.g. acute, subacute, or chronic). The phase can be established using the variable of time since injury and then adjusted to a client's clinical situation.

4.6.3. Pain experience

Whiplash-associated pain in the acute phase, when tissue damage is most severe and unresolved, is related foremost to the objective severity of injury. In this phase, pain is directly the result of sensory signaling of tissue damage. A client's pain at any time may also include psychosocial features of the injury and pain experience [46]. Psychosocial features of pain result from a client's perceptions about the importance and meaning of sensory pain. The consequences of psychosocial pain range from worse described pain (e.g., more intense, more widespread) through to lifestyle changes (e.g., poor participation in nADL, functional disability), physical effects (e.g., panic) and psychological effects (e.g., poor ego-integrity, poor environment mastery). Consequences can involve feelings of uncertainty, anxiety, distress, hopelessness, helplessness and fear of pain or pain-causing possibilities. Pain may be influenced by gender, a client's belief in the effectiveness of treatment, strong emotional states (e.g., anxiety) and cultural, family and work factors [22,34, 39,46,54]. The most overt is emotionality: a reaction to pain-related situations, ideas, interventions or consequences that is judged by expert opinion to be excessive and self-harming. Management of psychosocial features within a client's pain experience is ubiquitous within chiropractic care. Practice should involve an assessment of the proportion of psychosocial features within a client's pain experience. Psychosocial pain has been studied in WAD. Söderlund et al. [66] concluded that among 33 WAD-1 to WAD-3 subjects with continuous symptoms 3 months after injury, subjects with high Self-Efficacy Scale [62] scores were better able to manage their pain (e.g. greater confidence in their ability to complete activities of daily living). A separate WAD study with 40 subjects [10] showed low self-efficacy is predictive of persistent disability. Consequently, determining the proportion of psychosocial pain within a client's experience is clinically meaningful. If clinical judgment suggests that a client has a high proportion of psychosocial pain, consider performing a validated test to confirm the assessment. The GDC deemed that at least several tools are helpful in measuring psychosocial pain within a client's pain experience and inform the decision as to the need for multidisciplinary care. These include the Bournemouth Questionnaire [4], McGill Pain Questionnaire [45], Self Efficacy Scale [62] and Pain Catastrophizing Scale [74]. If a client has a high proportion of psychosocial pain, focus on multidisciplinary management of cognitive or behavioral components outside of chiropractic care.

4.6.4. Chronicity factors

The likelihood of chronicity can be roughly predicted by the presence or intensity of risk factors before or after injury. One study identified initial cervical disability, high levels of psychological distress, the severity of signs and symptoms (WAD grade) and the collision factors as predictors of pain at 1, 3 and 12 months [3]. Another study [30] showed that the use of pain medication before the whiplash-causing accident predicted poorer recovery in the long term. Separately, in extensively treated clients with undefined WAD, low pain immediately after injury was associated with "recovery" [42]. These observations support the conclusion of several studies that high initial pain is predictive of poor recovery [3,12,60]. Hendriks et al. [30] analyzed 119 subjects with WAD-1 or WAD-2 two weeks after injury for factors predictive of functional recovery at 4, 12 or 52 weeks. Results suggest that general recovery in the medium and long term was predicted at 2 weeks by youthfulness, high level of education, low intensity of neck pain, lack of somatization or sleep difficulties, ableness in work activities, male gender, marital status, greater cROM and less than 9 complaints. Sterling et al. [69] measured disability for 76 clients with WAD-2 or -3 within 1 month after injury. Subjects were treated predominantly with physiotherapy, but some chiropractic, acupuncture and pharmacotherapy were also used. General recovery was predicted at 6 months by youthfulness, male gender, low Neck Disability Index scores, normal range of rotation, high cold pain thresholds, good sympathetic reactivity and low emotional distress. A client's chronicity factors can guide treatment for each phase of healing.

The GDC recommends that chiropractors use the criteria put forth by the BJD TF for the consideration and identification of potential chronicity factors [11]:

- *Demographic and socioeconomic factors:* Increasing age in years, lower educational level, female gender are associated with chronicity;
- *Prior health or pain status:* Prior cervical pain or headache before injury predicts greater pain or poorer recovery;
- *Collision factors:* Are inconsistently predictive of pain or recovery;

- *Symptom severity:* Initial cervical disability and high pain immediately after injury predicts poorer recovery;
- *Psychological and social factors:* Passive coping predicts greater pain or poorer recovery; depression, kinesiophobia, catastrophizing and initial post-injury anxiety predicts poorer recovery; Low self-efficacy predicts greater pain or poorer recovery;
- *Compensation and legal factors:* Are predictive of poorer recovery;
- *Health behaviors and interventions*: Frequent post-injury use of health care is associated with poorer recovery.

The GDC consensus is that the chiropractor should assess the client's risk for chronicity in the acute phase, with a view to the client's longer-term care. If required, the chiropractor should prepare the client for a different pattern of care once tissue healing has advanced to the repair/remodeling phase. The chiropractor should choose treatment options that limit a client's propensity for chronicity and that are simple and cost-effective.

The WAD-Plus Model is relevant to clinical practice and is presented by the GDC as an important tool for chiropractors, for researchers and clinicians supporting multidisciplinary approaches in managing pain and disability associated with WAD. This model addresses the complexities of WAD and organizes care with respect to a client's clinical context (WAD grade, time since injury, pain experience, chronicity factors). Assessment of each of the WAD-Plus dimensions helps guide the frequency, dosage and duration of treatment modalities. In addition, the model helps flag when a client is improving on one dimension but not another, and care can be tailored accordingly.

Organizing the evidence by acute, subacute, and chronic WAD is clinically relevant because response to treatment is different across each category. Treatment modalities applicable to and recommended for acute or subacute WAD (e.g. posture advice/instruction) are not necessarily appropriate for chronic WAD. Similarly, treatment modalities for chronic WAD are not necessarily applicable for acute WAD (e.g. psychological counseling/CBT).

The dimensions in the WAD-Plus Model and the trends in the evidence supporting multidimensional approaches in managing chronic pain can be used as a framework for guiding interprofessional or multidisciplinary approaches in WAD care. The WAD-Plus Model provides a common basis for understanding the realm of factors that need to be considered in establishing shared goals for care among professionals working with persons with acute, subacute or chronic WAD. As well, the four dimensions of the WAD-Plus Model can support multidisciplinary teams of professionals in choosing assessments that add essential knowledge about these dimensions and to support the realm of interventions needed to comprehensively address the complex issues associated with the prevention of chronicity and subsequent disability. For groups of researchers with shared interests in improving the health and occupational outcomes of persons experiencing WAD, the WAD-Plus Model affords a common set of dimensions to support comparison of interventions for acute, subacute and chronic WAD across studies.

5. Discussion

5.1. The need for further research

The findings of this review of the literature underscore that there is a baseline of low levels of evidence to support the chiropractic management of WAD. Findings from this review also highlight that the evidence is suggestive or determined by consensus rather than conclusive evidence. In addition gaps and limitations in the current research are identified. As a result, efforts are needed to improve the rigor and quality of studies to advance the evidence base on effective chiropractic treatment of clients with WAD. Research strategies for addressing gaps, enhancing future investigations and using the dimensions of the WAD-Plus Model to support a systematic approach to the study of chiropractic WAD care need to be developed. It is suggested that the WAD-Plus Model might enhance the comparison of information collected and studies relevant to advancing the evidence of chiropractic management of clients with WAD. Furthermore, research is needed on the dimensions of the WAD-Plus Model for use in multidisciplinary approaches to WAD management.

5.2. Gaps in current evidence on WAD interventions

This paper does not provide a comprehensive review of all chiropractic treatment modalities. If a treatment is not mentioned, it is because the GDC did not retrieve published evidence to comment about it based on predefined literature search criteria. In addition, there is research that utilizes claims data to assess the prognosis of whiplash clients that was not retrieved by the GDC's literature search because specific treatment modalities

and WAD grades were undefined in the original papers [13]. Nevertheless, such findings are of interest to this review because results support the notion that activation improves prognosis in WAD. Also, clients' over reliance on clinical care within the first month following whiplash injury may delay recovery possibly by promoting passive coping strategies [13,14].

A major challenge with intervention studies on WAD is a lack of consistency in: reporting on study subjects, WAD grades, health outcomes, time since injury, lack of common terms and definitions for a short, medium or long course of treatment and the health outcomes across time. The lack of a systematic or standard approach to the study of WAD interventions in the acute, subacute or chronic stages in treating WAD will continue to contribute to the complexity and difficulties in integrating evidence relevant for practice. Findings in this paper show that the majority of the studies reflect interventions used in the acute phase and that there is less research on interventions in subacute and chronic WAD. More study is indicated across these phases of WAD. In addition, while cROM and pain are commonly reported health outcomes in the acute period, the health outcomes examined in subacute and chronic are diverse. Future study of health outcomes in chiropractic care for WAD should be congruent and consistent. Studies should use health outcome measures that are coherent with the intervention, the time period of care, and the clients' goals for returning to work and/or resuming meaningful participation in daily and social life. Moreover, many of the intervention studies did not report adequate control groups, nor did they explicitly report treatment effects over time. Thus, the lack of control groups makes it difficult to support conclusions as to whether a specific treatment is more effective than no treatment or alternative treatment. While this may reflect the ethical difficulty associated with not treating clients, there are study designs that will support the comparison of treatments on health outcomes.

Most North American chiropractors use diversified technique that involves HVLA manipulation [15]. Yet in the literature searches completed, only 1 study using retrospective case analyses investigated HVLA [77]. No other studies were found that directly support or refute the use of HVLA manipulation for the treatment of WAD. More specific research on the use of HVLA manipulation in the treatment of WAD is warranted.

5.3. Advancing research on WAD and health outcomes

Beyond the lack of studies on HVLA there is a need to address the other remaining gaps using methods that provide a better understanding of WAD. Notably absent in all studies was a discussion on adverse events in the treatment of WAD. Future studies should address the risk of adverse events, even if none are found in the existing study. In addition, WAD grade and phase of healing are fairly well understood, whereas chronicity factors and psychosocial features of WAD are poorly understood. It is for these reasons that the WAD-Plus Model was developed as a framework for understanding the clinical dimensions of WAD. An understanding of the evidence-based treatment of WAD will be limited until all dimensions are systematically disclosed in study subject descriptions and outcomes. Research is needed in this area not only to support evidence-based care of WAD but also to address issues relevant to the context of chiropractic WAD care.

The GDC consensus is that there is a need for discussion of adverse events in WAD research, even if no adverse events are encountered. There is also a need for research which must address and document the clients' pain experience (sensory vs. psychosocial), chronicity factors, WAD grade and time since injury to ensure the rigor of results and data interpretation. Furthermore, there is also a need for interdisciplinary research incorporating the WAD-Plus Model. Research is needed on the use of the dimensions in this model in guiding clients and interprofessional teams of clinicians in graduating the resumption of activities and occupations such as productive work.

Future WAD studies will require research designs using active comparators, non-treatment and/or placebo group(s) to enhance the evidence-base for client care. The lack of systematically reported studies presents a practical challenge for generating evidence-based treatment recommendations. While this situation results from the multidimensional nature of the disorder, the idiosyncratic way that the condition presents and limitations in research funding, more consistent and structured effort is needed. The GDC consensus is that there needs to be studies on combinations of treatment modalities rather than individual modalities rarely used alone or in ad-hoc combinations. Studies should be structured (when possible) using systematic, validated methods (e.g., Consolidated Standards of Reporting Trials [CONSORT], Transparent Reporting of Evaluations with Non-randomized Designs [TREND]) [1,17, 47].

This review identified that WAD intervention studies utilize a variable range of measures in evaluating the effect of treatment on health outcomes. Pain and cROM are the most consistently used outcomes. The tools and

instruments used in determining those outcomes vary widely in reliability and validity. This inconsistency makes it difficult to compare outcomes across studies and to build knowledge. Serious efforts are needed to identify rigorous outcome measures that are consistent and congruent with the proposed WAD-Plus Model and can be used by all disciplines interested in systematically advancing the evidence and knowledge on the management of WAD. The GDC recommends that an interdisciplinary consensus be developed on a consistent standard of outcome measures to be used for all future studies on WAD.

In addition the outcome measures used in the study on the care and management of WAD are focused on health outcomes of the person. While these outcomes are valued in terms of evidence-based practice by health care professionals, they are not the only outcomes of concern by persons with WAD. Persons experiencing WAD, live, function and work in a daily life context, yet little effort or attention is placed on the improved social or occupational outcomes for persons with WAD. Given, that the limited evidence that does exist suggests more active treatments and more involvement of persons in their care, more research is needed to identify and measure the broader realm of health, participation and productivity outcomes that are achieved through the management of WAD.

6. Conclusion

There is a baseline of low levels of evidence that suggests chiropractic care improves cROM and pain in the management of WAD. This knowledge base of evidence can be strengthened on WAD care by efforts of researchers and clinicians across disciplines with a shared interest in WAD to adopt a more consistent approach to studying WAD interventions and expanding the realm of outcomes used. The WAD-Plus Model is posited for use to improve consistency and quality in chiropractic care, interprofessional approaches to the management of WAD care, and advance research needed to inform evidence-based WAD practice.

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