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Invited Topical Review

Physiotherapy management of whiplash-associated disorders (WAD)

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KEY WORDS

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Introduction

'Whiplash-associated disorders' (WAD) is the term given to the variety of symptoms often reported by people following acceleration/deceleration injury to the neck, most commonly via a road traffic crash. The cardinal symptom is neck pain but neck stiffness, dizziness, paraesthesia/anaesthesia in the upper quadrant, headache and arm pain are also commonly reported. The neck-related pain is associated with disability, decreased quality of life, and psychological distress. Due to WAD often being a compensable injury, it is a controversial condition, with some still denying it as a legitimate condition.[1] This is despite the wealth of evidence demonstrating both physical and psychological manifestations that have implications for management. This narrative review will outline the burden of WAD, the clinical pathway following injury, and factors predictive of both good and poor recovery. The diagnosis and assessment of WAD will be discussed. This will be followed by an overview of the current evidence for management of the condition and future directions for research and clinical practice in order to improve health outcomes for this condition.

The burden of WAD

Whiplash injury following a road traffic crash is common, with recent figures suggesting more than 300 persons per 100,000 are seen in emergency departments every year in Europe and North America,[2] and in Australia, whiplash injuries comprise ~75% of all survivable road traffic crash injuries.[3] Musculoskeletal conditions and injuries from road traffic crashes account for a large proportion of disease burden worldwide, with the burden associated with such conditions increasing.[4] The economic costs of whiplash injuries in Queensland, Australia are substantial and exceeded $350 million from 2011 to 2012.[5] In New South Wales in the period 1989–1998, there were 50,000 whiplash compulsory third-party claims costing ~$1.5 billion.[6] The total costs associated with whiplash injury exceed costs for both spinal cord and traumatic brain injury sustained in road traffic crashes.[5] The situation is little different in other Western countries. For example, in the United Kingdom, whiplash personal injury claims exceeded £3 billion per year,[7] while in the United States, costs reached US$230 billion per annum in 2000.[8]

Consistent international data indicate that approximately 50% of people who sustain a whiplash injury will not recover but will continue to report ongoing pain and disability one year after the injury.[2] Mental health outcomes are also poor, with the prevalence of psychiatric disorders in people with persistent WAD being 25% for post-traumatic stress disorder,[9–11] 31% for Major Depressive Episode, and 20% for Generalised Anxiety Disorder.[11] Individuals with mental health problems report higher levels of disability, pain, and reduced physical function,[12,13] and conditions with comorbid physical injury and psychiatric disorder are associated with double the health care utilisation and considerably greater time off work compared to those with physical injury alone.[11]

Clinical course of WAD and prognostic factors for recovery and non-recovery

Cohort studies have demonstrated that recovery, if it occurs, takes place within the first 2–3 months following the injury with a plateau in recovery following this time point.[10,14] Even in those with poor overall recovery, there appears to be an initial decrease in symptoms to some extent in this early post-injury period. Recently, three distinct clinical recovery pathways following whiplash injury were identified using trajectory-modelling analysis.[10] The first is a pathway of good recovery, where initial levels of pain-related disability were mild to moderate and recovery was good, with 45% of people predicted to follow this pathway. The second pathway involves initial moderate to severe pain-related disability, with some recovery but with disability levels remaining moderate at 12 months. Around 39% of injured people are predicted to follow this pathway. The third pathway involves initial severe pain-related disability and some recovery to moderate or severe disability, with

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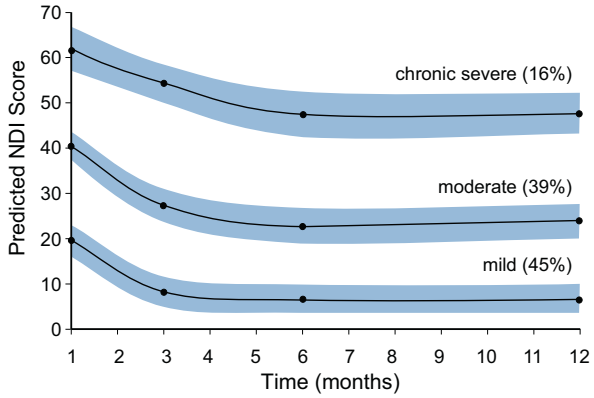

Figure 1. Predicted Neck Disability Index (NDI) trajectories with 95% confidence limits and predicted probability of membership (%). Suggested cut-offs for the NDI are: 0 to 8% (no pain and disability); 10–28% (mild pain and disability), 30–48% (moderate pain and disability), 50–68% (severe pain and disability) and >70% complete disability.[75]

Modified from Sterling et al[10] with permission.

16% of individuals predicted to follow this pathway. The identified pathways are illustrated in Figure 1. They may provide useful conceptualisation for clinicians of the possible recovery trajectories.

With up to 50% of those sustaining a whiplash injury reporting ongoing pain and disability, it is of clinical interest to be able to identify both those at risk of poor recovery and those who will recover well. This may assist in targeting ever-shrinking health resources to those in most need of them. The most consistent risk factors for poor recovery are initially higher levels of reported pain and initially higher levels of disability.[2,15] A recent meta-analysis indicated that initial pain scores of >5.5 on a visual analogue scale from 0 to 10 and scores of >29% on the Neck Disability Index are useful cut-off scores for clinical use.[15] In view of the consistency of these two factors to predict poor functional recovery, they are recommended for use by physiotherapists in the assessment of patients with acute WAD.

Other prognostic factors have been identified, including psychological factors of initial moderate post-traumatic stress symptoms, pain catastrophising and symptoms of depressed mood.[2,16,17] Additionally, lower expectations of recovery have been shown to predict poor recovery.[18,19] In other words, patients who do not expect to recover well may indeed not recover.

Cold hyperalgesia has been shown to predict disability and mental health outcomes at 12 months post-injury,[19,28,48] and decreased cold pain tolerance measured with the cold-pressor test predicted ongoing disability.[21] A recent systematic review concluded that there is now moderate evidence available to support cold hyperalgesia as an adverse prognostic indicator.[22] Other sensory measures such as lowered pressure pain thresholds (mechanical hyperalgesia) show inconsistent prognostic capacity. Walton et al showed that decreased pressure pain thresholds over a distal site in the leg predicted neck pain-related disability at 3 months post-injury,[23] but other studies have shown that this factor is not an independent predictor of later disability.[20] The exact mechanisms underlying the hyperalgesic responses are not clearly understood, but are generally acknowledged to reflect augmented nociceptive processing in the central nervous system or central hyperexcitability.[24,25]

Some factors commonly assessed by physiotherapists do not show prognostic capacity. These factors include measures of motor and sensorimotor function such as the craniocervical flexion test, joint repositioning errors, and balance loss.[26] Decreased range of neck movement is inconsistent in that some studies have found it to be predictive and others have not.[15] This is not to say that these factors should not be considered in the clinical assessment of patients with WAD, but they should not be used to gauge prognosis. Other factors commonly considered to predict outcome, such as those associated with compensation processes and accident-related factors, are not robust prognostic indicators.[27] Similarly, demographic or social factors such as age, income and educational levels demonstrate inconsistent prognostic capacity.[2,15]

Most prognostic studies of WAD have been phase 1 or exploratory studies, with few confirmatory or validation studies having been conducted.[28] Validation studies are important in order to confirm the prognostic capacity of identified factors in a new and independent cohort. A recent study undertook validation of a set of prognostic indicators including initial disability, cold hyperalgesia, age and post-traumatic stress symptoms. The results indicated that the set showed good accuracy (area under the curve 0.89, 95% CI 0.84 to 0.94) in discriminating patients with moderate/severe disability from patients with full recovery or residual milder symptoms at 12 months post-injury.[16] These results are clinically useful, as physiotherapists usually aim to broadly identify patients likely to report persistent moderate to severe symptoms. Such a validation study is rare in this area of research and goes some way towards providing greater confidence for the use of these measures in the early assessment of whiplash injury.

Based on the results of previous cohort studies, a clinical prediction rule to identify both chronic moderate/severe disability and full recovery at 12 months post-injury was recently developed. The results indicated that an initial Neck Disability Index score of $\geq$40%, age $\geq$35 years, and a score of $\geq$6 on the hyperarousal subscale of the Posttraumatic Stress Diagnostic Scale[29] could predict patients with moderate/severe disability at 12 months with fair sensitivity (43%, 95% CI 31 to 55), good specificity (94%, 95% CI 89 to 96), and a positive predictive value of 71% (95% CI 55 to 84).[30] It is also important to predict patients who will recover well as these patients will likely require less intensive intervention. Initial Neck Disability Index scores of $\leq$32% and age $\leq$35 years predicted full recovery at 12 months post-injury, with a positive predictive value of 71%.[30] A third medium-risk group could either recover or develop chronic pain and disability (>32% on the Neck Disability Index, score >3 on the hyperarousal subscale). The hyperarousal subscale comprises five items that evaluate the frequency of symptoms including: having trouble falling asleep, feelings of irritability, difficulty concentrating, being overly alert, and being easily startled.[31]

In summary, Box 1 presents consistent prognostic indicators for poor functional recovery, factors with consistent evidence of not being associated with poor recovery, and factors with inconsistent evidence.

Diagnosis and assessment

The Quebec Task Force (QTF) classification of whiplash injuries (presented in Table 1') was put forward in 1995[32] and it remains the classification method still currently used throughout the world. Whilst the QTF system is rather simplistic and based only on signs and symptoms, it allows practitioners and other stakeholders involved in the management of patients with WAD to have a common language about the condition. Most patients fall into the WAD II classification, although health outcomes for this group can be diverse and this has been outlined as one problem with the QTF system.[33] Modifications to the QTF system have been proposed but have generally been more complicated[33] and, for this reason, not easily taken up by all stakeholders involved in the management of WAD.

The diagnosis of WAD has changed little in recent times. In the vast majority of cases, specific tissue damage or a peripheral

Box 1. Prognostic indictors of poor functional recovery following whiplash injury based on findings of systematic reviews.[2,15,17,22,26]

Factors showing consistent evidence for being prognostic indicators for poor recovery	Factors showing consistent evidence of not being prognostic indicators	Factors with inconsistent evidence
• Initial pain levels: >5.5/10 • Initial disability levels: NDI > 29% • Symptoms of post-traumatic stress • Negative expectations of recovery • High pain catastrophising • Cold hyperalgesia	• Accident related features (eg, collision awareness, position in vehicle, speed of accident) • Findings on imaging • Motor dysfunction	• Older age • Female gender • Neck range of movement • Compensation-related factors

lesion cannot be identified.[34] Although earlier research identified lesions in the cervical spine at autopsy in people who have died as a result of a road traffic crash,[35] this research has not translated to the clinical environment, likely due to insensitivity of available imaging techniques. The strongest clinical evidence available is for the zygapophyseal joint pathology detected via radiofrequency neurotomy techniques in highly selected patients with chronic WAD,[36] but their prevalence in the general WAD population is not known. It is likely that injury to other structures including cervical discs, ligaments, and nerve tissue is present to varying degrees in some patients.[34]

Current clinical guidelines for the management of acute WAD recommend that radiological imaging be undertaken only to detect WAD grade IV (ie, fracture or dislocation) and that clinicians adhere to the Canadian C-Spine rule or Nexus rule when making the decision to refer the patient for radiographic examination.[37] These rules show very high sensitivity and specificity to detect WAD IV.[36] There is no evidence to support the use of imaging in any form in WAD II. For WAD III (neurological compromise), imaging may be used based on clinical judgement to further evaluate suspected nerve compromise.[37] Thus, the diagnosis of WAD is made on patient-reported symptoms – neck pain and related symptoms following a traumatic event, usually a road traffic crash. In contrast to the lack of progress made in the diagnosis of peripheral pathology, much ground has been made in characterising the condition in terms of its physical and psychological presentation, and some of the key findings in this area have implications for the clinical assessment of WAD, and these will be outlined.

Table 1
Quebec Task Force (QTF) classification of whiplash associated disorders.[32]

QTF classification grade	Clinical presentation
0	No complaint about neck pain No physical signs
I	Neck complaint of pain, stiffness or tenderness only No physical signs
II	Neck complaint Musculoskeletal signs including: • decreased range of movement • point tenderness
III	Neck complaint Neurological signs including: • decreased or absent deep tendon reflexes • muscle weakness • sensory deficits
IV	Neck complaint and fracture or dislocation

Patient history and interview

It is mandatory that pain and disability be measured as the first step of clinical assessment due to their consistent prognostic capacity. Guideline-recommended pain measures include the 11-point visual analogue scale or numeric rating scale, and the recommended measure of disability is the Neck Disability Index due its clinimetric properties.[37] However, other measures are also acceptable, and some include the Whiplash Disability Questionnaire and the Patient Specific Functional Scale.[37]

It is also important to gain an understanding of any psychological factors that may influence recovery or the effects of physiotherapy interventions. Numerous psychological questionnaires are available so it is often difficult for clinicians to decide on the most appropriate questionnaire/s to use. One suggestion is to select relevant questionnaires based on the patient's reported symptoms in the subjective examination. For example, early symptoms of post-traumatic stress may be suspected in patients who report difficulty sleeping due to thoughts about the accident, flashbacks, or avoidance of driving due to fear. These symptoms can be further evaluated using validated questionnaires, with the Impact of Events Scale recommended for use by physiotherapists.[37] A score of 25 or 26 on the Impact of Events Scale indicates a moderate level of symptoms of post-traumatic stress.[38] Similarly, if from the patient history and interview, it appears that other psychological factors are present, these can also be further evaluated. Table 2 outlines some questionnaires that may be useful for physiotherapists, the interpretation of scores, and

Table 2
Questionnaires measuring psychological constructs with evidence of being prognostic indicators for poor functional recovery, relevant threshold scores that may be useful in the assessment of WAD.

Assessment tool	Description	Availability	Construct measured	Interpretation of scores
Impact of Events Scale	15 item questionnaire	www.maa.nsw.gov.au Whiplash Guidelines[a]	Post-traumatic stress symptoms (intrusion and avoidance subscales)	25 or 26: moderate symptoms 43: severe symptoms
Patient Health Questionnaire-9	9 item questionnaire	www.phqscreeners.com	Brief screen for depression	5: mild 10: moderate (yellow flag) 15: severe (red flag)
Pain Catastrophising Scale	13 item questionnaire	www.tac.gov.au	Pain catastrophising	≥24: clinically relevant[b]

[a] Motor Accident Authority.[37]
[b] Sullivan et al[76]

their availability. Management decisions made on the basis of responses on these questionnaires depend on the stage of the condition, whether acute or chronic, and this will be discussed below.

Physical examination

The physical examination of the patient with WAD follows the same general examination procedures usually adopted for the examination of any cervical spine condition but with some additional procedures included based on research findings of WAD. One aim of the physical examination is to determine the grade of the condition using the QTF classification system.[32] A Grade II condition will have physical signs of decreased range of neck movement and palpable 'tenderness' compared to Grade I, where the patient reports neck pain but with no physical signs. Grade III is determined via the presence of clinical neurological signs of decreased muscle strength, deep tendon reflexes, and sensation in a dermatomal or myotomal distribution. It should be noted that many patients with WAD will report diffuse symptoms of sensory loss or gain and generalised muscle weakness, both of which may be bilateral, but these findings do not necessarily indicate peripheral nerve compromise and may be a reflection of altered central nociceptive processes.

Much research has focused on the investigation of nociceptive processes in WAD. Systematic reviews conclude that there is strong evidence for the presence of augmented central nervous system processing of nociception in chronic WAD[25,39] and moderate evidence that cold hyperalgesia (a likely indicator of these processes) is associated with poor recovery from the injury.[22] Clinically, central hyperexcitability may be suspected from subjective reports of the patient, including: reports of allodynia, high irritability of pain, cold sensitivity, and poor sleep due to pain, amongst others. Further assessment of these symptoms may be undertaken using a validated questionnaire such as the self-reported Leeds Assessment of Neuropathic Symptoms and Signs to assess for a neuropathic pain component.[40] Physical tests may include the use of pressure algometers, pain with the application of ice,[41] or with demonstrated increased bilateral responses to the brachial plexus provocation test.[42] Physiotherapists may need to be aware of the presence of such findings because preliminary evidence suggests that patients with chronic WAD and generalised sensitivity to the stimuli may not respond as well to physical rehabilitation[43] and, as outlined previously, cold hyperalgesia is a predictor of poor recovery.[22]

In recent years, there has also been extensive research undertaken demonstrating movement, muscle, and motor control changes in the neck and shoulder girdles of patients with neck pain, including WAD. Study findings include inferior performance on tests of motor control involving the cervical flexor, extensor and scapular muscle groups when compared to asymptomatic control participants; changes in muscle morphology of the cervical flexor and extensor muscles; loss of strength and endurance of cervical and scapular muscle groups; and sensorimotor changes manifested by increased joint re-positioning errors, poor kinaesthetic awareness, altered eye movement control, and loss of balance.[44,45] Detailed information on the clinical assessment of cervical motor function is available elsewhere.[46] The rationale for the evaluation of such features is to plan an individualised exercise program for each patient based on the assessment findings.

Management

The management of WAD varies to some extent depending upon whether the condition is in the early acute stages (usually defined as 0–12 weeks) or a chronic condition has already developed (>12 weeks post-injury). These time frames are arbitrary, but are used because they are consistent with current guidelines for the management of WAD.[37,47] The clinical course of WAD, where most recovery occurs in the first 2–3 months, is important because this time frame offers the opportunity to potentially prevent the development of a chronic condition. As both physical and psychological factors are present in both acute and chronic WAD and there is evidence of close relationships between these factors,[48] management approaches should be in accordance with the current biopsychosocial model. Surprisingly for a condition that incurs significant personal and economic burden, there have been relatively few trials of treatment compared to some other musculoskeletal pain conditions.

Exercise and activity

The mainstay of management for acute WAD is the provision of advice encouraging return to usual activity and exercise, and this approach is advocated in current clinical guidelines.[37] Various types of exercise have been investigated, including range-of-movement exercises, McKenzie exercises, postural exercises, and strengthening and motor control exercises.[49] However, the treatment effects of exercise are generally small, with recent systematic reviews concluding that there is only modest evidence available supporting activity/exercise for acute WAD.[49,50] It is not clear which type of exercise is more effective or if specific exercise is more effective than general activity or merely advice to remain active.[49] Nevertheless, activity and exercise are superior to restricting movement with a soft collar, where there is strong evidence that immobilisation (collars, rest) is ineffective for the management of acute WAD.[49]

Inspection of data from clinical trials reveals that despite active approaches being superior to rest, a significant proportion of people still develop chronic pain and disability.[51,52–60] This was also the case in a recent randomised trial conducted in emergency departments of UK hospitals. The results of the trial demonstrated that six sessions of physiotherapy (a multimodal approach of exercise and manual therapy) was only slightly more effective than a single session of advice from a physiotherapist.[55] However, only 45–50% of participants in either treatment group reported their condition as being 'much better' or 'better' at short- (4 months) and long-term follow-up (12 months) – a low recovery rate that is little different to the usual natural recovery following the injury.[10]

Whilst there may be a slightly greater number of treatment trials for chronic WAD than acute WAD, they are still sparse compared to other musculoskeletal conditions. A recent systematic review identified only 22 randomised trials that met the criteria for inclusion, and only 12 were of good quality.[56] The authors concluded that exercise programs are effective at relieving pain, although it does not appear that these gains are maintained over the long term.[56] Similar to the situation with acute WAD, it is not clear if one form of exercise is more effective than another. For example, a graded functional exercise approach and advice demonstrated greater improvements in pain intensity, pain bothersomeness and functional ability, compared to advice alone.[57] In another trial, similar effects were demonstrated when the exercise investigated was a specific motor and sensorimotor retraining program for the cervical spine combined with manual therapy.[43] Other studies have investigated muscle strength and endurance training, vestibular exercises, and exercises designed to challenge the postural system, with similar effects regardless of the exercise type.[56]

In a preliminary investigation, one randomised trial explored factors that may moderate the effects of a predominantly exercise-based intervention and found that participants with both cold and mechanical hyperalgesia did not respond to the intervention.[43] However, these findings are limited by the small sample size and

have not been replicated in a larger trial.[58] So at present it is not clear which patients will respond to exercise approaches.

From a clinical perspective, exercise and activity should be used in the treatment of both acute and chronic WAD. However, there is no evidence to indicate that one form of exercise is superior to another and this is an area that requires further research. The generally small effect sizes with exercise suggest that either additional treatments will be needed, or that it is a sub-group of patients who show a better response. However, due to a lack of evidence, it is not clear which additional treatments should be included or how to clearly identify responders and non-responders. Thus, the recommendation to clinicians is that health outcomes should be monitored and treatment continued only when there is clear improvement. In patients whose condition is not improving, the clinician will need to look for other factors that may be involved, such as psychological, environmental, or nociceptive processing factors amongst others.

Education and advice

Various information and educational approaches including information booklets, websites and videos have been investigated for their effectiveness in improving outcomes following whiplash injury.[59] In one trial, an educational video of advice focusing on activation was more beneficial in decreasing WAD symptoms than no treatment at 24 weeks follow-up (outcome: no/mild symptoms vs moderate/severe symptoms), RR 0.79 (95% CI 0.59 to 1.06), but not at 52 weeks, RR 0.89 (95% CI 0.65 to 1.21).[59] The results of other trials were equivocal and overall none of the interventions studied reduced the proportion of patients who developed chronic WAD. Currently, there appears to be wide variability in the nature of information and advice provided to a patient, suggesting that the best educational approaches as well as strategies for behaviour change and system change are yet to be established.[60] Although patients understandably want advice on the prognosis and implications of their injury,[61] it is not clear that advice per se will improve long-term outcomes or prevent chronic pain development. There have been no trials of educational interventions for chronic WAD, but approaches that teach patients about pain neurophysiology have shown some effect in other chronic pain conditions and may also be useful in the management of WAD.[62]

Spinal manual therapy

Spinal manual therapy is commonly used in the clinical management of neck pain. It is difficult to tease out the effects of manual therapy alone because most studies have used it as part of a multimodal package of treatment. Systematic reviews of the few trials that have assessed manual therapy techniques alone conclude that manual therapy applied to the cervical spine (passive mobilisation) may provide some benefit in reducing pain, but that the included trials were of low quality.[49,50,56] One low-quality trial found that manipulative thrust techniques to the thoracic spine added to multimodal physiotherapy treatment resulted in a greater reduction of pain than multimodal physiotherapy alone, but the effect was small (SMD −0.68, 95% CI −1.11 to −0.25).[63] There have been no randomised controlled trials of spinal manual therapy alone for chronic WAD. In view of the current evidence, clinical guidelines advocate that manual therapy can be used in conjunction with exercise and advice, if there is evidence of continued benefit via validated outcome measures.[37]

Medication

Whilst not traditionally a physiotherapy treatment, physiotherapists often recommend over-the-counter medications to patients or communicate with the patient's general practitioner regarding the need for medication. For acute WAD, it would seem logical that, as with any acute injury or trauma, the provision of pain medication in the early stages would be appropriate,[64] particularly considering that initial higher levels of pain are associated with poor recovery from whiplash injury and that features indicative of central hyperexcitability are common. Yet there have been very few trials of medication in acute WAD. One early study showed that intravenous infusion of methylprednisolone provided in a hospital emergency department for acute whiplash resulted in fewer sick days over 6 months and less pain-related disability than those who received placebo medication.[65] Whilst this is an interesting finding, it would not be feasible in primary care settings and may have potentially harmful effects.[37] In a recent randomised controlled trial, little pain relief was obtained from muscle relaxants either alone or combined with non-steroidal anti-inflammatory drugs for emergency department patients with acute whiplash.[66] There have also been few trials of medication for chronic WAD. This is in contrast to other conditions such as low back pain and fibromyalgia, the latter of which shows a similar sensory presentation to chronic WAD. Current clinical guidelines recommend, on consensus, that general pain management guidelines[64] are followed for the provision of medication to patients with acute and chronic WAD[37] until further evidence becomes available.

Interdisciplinary approaches

As can be seen from the evidence outlined above, there are currently few effective treatments available for acute WAD. One reason proposed for this is that a 'one size fits all' approach has been used, and this is sub-optimal as it ignores the well-documented heterogeneity of WAD.[67,68–70] There are now many data demonstrating that other factors shown to be present in acute WAD and associated with poor recovery may need to be considered in the early management of the condition. In particular, these include the sensory presentation of WAD, which allows some understanding of nociceptive processes involved, and psychological factors that may impede recovery. A recent high-quality randomised trial investigated if the early targeting of these factors would provide better outcomes than usual care. Participants with acute WAD ($\leq$4 weeks duration) were assessed using measures of pain, disability, sensory function and psychological factors, including general distress and post-traumatic stress symptoms. Treatment was tailored to the findings of this baseline assessment and could range from a multimodal physiotherapy approach of advice, exercise and manual therapy for those with few signs of central hyperexcitability and psychological distress to an interdisciplinary intervention comprising medication (if pain levels were greater than moderate and signs of central hyperexcitability were present) and cognitive behavioural therapy delivered by a clinical psychologist (if scores on psychological questionnaires were above threshold). This pragmatic intervention approach was compared to usual care where the patient could pursue treatment as they normally would. Analysis revealed no significant differences in frequency of recovery (defined as Neck Disability Index <8%) between pragmatic and usual-care groups at 6 months (OR 0.55, 95% CI 0.23 to 1.29) or 12 months (OR 0.65, 95% CI 0.28 to 1.47). There was no improvement in non-recovery rates at 6 months (64% for pragmatic care and 49% for usual care), indicating no advantage of the early interdisciplinary intervention.[71] Several possible reasons for these results were proposed. The design of the trial may have been too broad and not sensitive enough to detect changes in sub-groups of patients, suggesting better outcomes would be achieved by specifically selecting patients at high risk of poor recovery. With a clinical prediction rule now developed for WAD[30] and undergoing

validation, this approach can be evaluated in future trials. Additionally, 61% of participants in the trial found the medication (low-dose opioids and/or adjuvant agents) to be unacceptable due to side effects such as dizziness and drowsiness, and did not comply with the prescribed dose,[71] indicating that more acceptable medications need to be evaluated. Compliance with attending sessions with the clinical psychologist was less than compliance with physiotherapy, perhaps indicating patient preference for physiotherapy.

In accordance with the biopsychosocial model of chronic pain, it may be expected that management involving only physical therapy for chronic WAD will not be sufficient. Few trials of interdisciplinary approaches have been conducted in a chronic WAD group, and these approaches have been varied, from physiotherapists delivering psychological-type interventions in addition to physiotherapy to psychological interventions alone. In their systematic review, Teasell et al[56] concluded that although the majority of studies suggest that interdisciplinary interventions are beneficial, it is difficult to formulate conclusions given the heterogeneity of the interventions. Since that review, additional trials have investigated psychological approaches for chronic WAD. Dunne and colleagues[12] showed that trauma-focussed cognitive behavioural therapy provided to individuals with chronic WAD and post-traumatic stress disorder led to decreased psychological symptoms of post-traumatic stress disorder, anxiety and depression, as well as decreased pain-related disability. Although preliminary, the results of this study suggest that psychological interventions may be useful to improve not only psychological symptoms, but also pain-related disability.

From a clinical perspective, some individuals with WAD will report various psychological symptoms, particularly those with an already chronic condition. Psychological symptoms may be related to pain, for example, pain catastrophising, pain-related fear, pain coping strategies and other symptoms related to the traumatic event itself (road traffic crash), such as post-traumatic stress symptoms or post-traumatic stress disorder. Additionally, there is emerging evidence that feelings of injustice associated with the accident or compensation system[72] may also be present. Such factors will need to be evaluated in the clinical assessment of patients with WAD (see Table 2). If confident, the physiotherapist may then decide to manage them as part of their treatment plan or to initiate appropriate referral. This may be to the patient's general practitioner or a clinical psychologist for further assessment of the psychological symptoms. The decision to refer or not can be made via relevant questionnaires, with high scores indicating referral may be necessary and psychologically informed physiotherapy treatment for more moderate scores, but with reassessment and referral if no improvement is made.

Future directions

An important aim for the treatment of acute WAD is the identification of people at risk of poor recovery, and to then prevent the development of chronic pain and disability. Currently, there is a paucity of evidence available to guide the clinician to achieve this goal, and this is frustrating for clinicians and researchers alike. Whilst there is now much better understanding of the characteristics of the condition and factors predictive of poor recovery, much less progress has been made in the development of improved and effective interventions. The logical next step in the research process is to target these factors, many of which are potentially modifiable, with more specific interventions.

Education and advice to return to activity and exercise will still remain the cornerstones of early treatment for WAD, but they require further investigation to determine the most effective form of exercise, dose, and ways to deliver these approaches. Activity and exercise will likely be sufficient for patients at low risk of developing chronic pain, although this is yet to be formally tested. Those patients at medium or high risk of poor recovery will likely need additional treatments to the basic advice/activity/exercise approach. This may include medication to target pain and nociceptive processes as well as methods to address early psychological responses to injury. As was seen in the aforementioned interdisciplinary trial for acute WAD, this is not so easy to achieve.[71] The participants of this trial not only found the side effects of medication unacceptable, but also were less compliant with attendance to a clinical psychologist (46% of participants attended fewer than 4 of 10 sessions) compared to attendance with the physiotherapist (12% attended fewer than four sessions over 10 weeks). It is possible that people with acute whiplash injury see themselves as having a 'physical' injury and thus, are more accepting of physiotherapy. The burden of requiring visits with several practitioners may also lead to poor compliance. Physiotherapists may be the health care providers best placed to deliver psychological interventions for acute WAD. This approach has been investigated in mainly chronic conditions such as arthritis,[73] and recently, in the management of acute low back pain,[74] with results showing some early promise. This is not to say that patients with a diagnosed psychopathology such as depression or post-traumatic stress disorder should be managed by physiotherapists, and of course, these patients will require referral to an appropriately trained professional.

Physiotherapists may also need to take a greater role in the overall care plan of the patient with acute WAD. This would mean having expertise in the assessment of risk factors and an understanding of when additional treatments such as medication and psychological interventions are required. Whilst this has traditionally been the role of general practitioners, it is difficult to see how the busy structure of medical primary care will allow for the appropriate assessment of patients to first identify those at risk, develop a treatment plan, follow the patient's progress, and modify treatment as necessary.

In the case of chronic WAD, more effective interventions need development and testing. It is becoming clear that management approaches that focus predominantly on physical rehabilitation are achieving only small effect sizes. However, it is important for the long-term general health of patients that they undertake regular activity and exercise, and it is a concern if chronic pain prevents them from doing this. Randomised controlled trials are needed that combine activity/exercise approaches with other interventions such as psychological approaches, educational approaches and medication. The optimal combination and dosage of such approaches will need to be determined.

WAD, whether acute or chronic, is a challenging and complex condition. With clear evidence emerging of a myriad of physical and psychological factors occurring to varying degrees in individual patients, it is also clear that practitioners involved in the management of WAD need specific skills in this area. Physiotherapists are the health care providers who likely see the greatest number of patients with WAD, and by virtue of the health system set-up, spend the most time with these patients. Physiotherapists are well placed to take on a coordination or 'gatekeeper' role in the management of WAD and research into health services models that include physiotherapists in such a role is also needed.

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