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The symptom profile of people with whiplash-associated disorder – A mixed-method systematic review

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ABSTRACT

Background: Several studies have shown that people with whiplash-associated disorder (WAD) may experience diverse symptoms, and social, activity and participation limitations. However, the symptom profile of WAD is still unclear. Therefore, this systematic review aimed to identify the symptoms, impairments, activity limitations, and participation restrictions of people with WAD to construct a symptom profile.

Methods: The data search was performed using PubMed, Embase, PsycINFO, CINAHL, and Scopus databases. Full-text quantitative and qualitative studies reporting symptoms, impairments, activity and participation limitations, or environmental factors affecting them in people with WAD were included. The extracted data was synthesised using Joanna Briggs Institute's convergent integrated approach. The Critical Appraisal Skills Programme checklist was chosen to evaluate the quality of the studies.

Results: Fifty-three studies involving 102 943 people with WAD met the inclusion criteria. Three key themes were identified to describe the symptom profile: 1) the prevalence of symptoms, impairments or limitations; 2) the severity of symptoms and the effect of symptoms on functioning, activity and participation; and 3) the effects of environmental factors on the symptom profile. Two-thirds of the symptoms, impairments and limitations identified from the studies related to problems in body functions, and one-third to difficulties executing activities or participating in life situations.

Discussion: The literature describes a wide variety of symptoms in people with WAD. However, it does not adequately describe how these symptoms affect a patient's function, activity, or levels of participation. Considering the symptom profile after whiplash injury to be primarily neck-related may be misdirected.

1. Introduction

Whiplash refers to a sudden strong oscillating movement of the cervical spine (Siegmund, 2011), which can occur, for example, in motor vehicle crashes or in fall or diving injuries. It is estimated that the annual incidence of whiplash injury is at least 300 per 100 000 inhabitants (Holm et al., 2009), causing annual costs of approximately $2.7 billion in the U.S., £3 billion in the United Kingdom and $550 million in Sweden (Joslin et al., 2004; NHTSA 2010; Styrke et al., 2012). Although in many cases, functional capacity improves rapidly within three months after injury, at one year, nearly half of the injured report neck pain and 10–25% experience a significant decline in functional capacity and health (Carroll et al., 2008; Kamper et al., 2008; Miettinen et al., 2002; Sterling et al., 2010).

The effectiveness of comprehensive rehabilitation has remained modest in patients with whiplash-associated disorders (WAD). For example, active or specific physiotherapy has not shown additional benefits in reducing pain or disability compared to usual care or simple advice (Chrcanovic et al., 2021; Lamb et al., 2013; Michaleff and Ferreira, 2012; Michaleff et al., 2014). Furthermore, there is no evidence to support the use of psychological interventions in patients with WAD (Shearer et al., 2016). However, the Sterling et al. (2019) study showed that a physiotherapist-led intervention of stress inoculation training and exercise resulted in clinically relevant improvements in functional

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capacity compared with exercise alone in patients with acute WAD and hyper-arousal symptoms. This suggests that one possible reason for ineffective rehabilitation interventions may be related to deficient recognition of patients' symptoms.

Several patient-reported outcome measures (PROMs) have been developed to assess the symptoms and disability of patients with neck pain (Nordin et al., 2008), of which the Neck Disability Index (NDI) and Whiplash Disability Questionnaire (WDQ) have been identified as the most appropriate for patients with WAD (Griffin et al., 2021). Although the NDI and WDQ have been found to have sufficient clinimetric performance in terms of reliability, construct validity, and responsiveness (Griffin et al., 2021), they have also been criticized for lacking content validity and dimensionality (Griffin et al., 2021; Hoving et al., 2003; Pinfold et al., 2004; Schmitt et al., 2013). Therefore, it has remained unclear whether the content of these PROMs adequately reflects the construct to be measured (Mokkink et al., 2010; Terwee et al., 2018).

A broad spectrum of symptoms and limitations have been reported in people with WAD (Hoving et al., 2003; Pinfold et al., 2004; Schmitt et al., 2013). However, a systematic synthesis to identify these symptoms and limitations in WAD populations is yet to be undertaken. Identifying the most common and relevant symptoms, impairments, and functional limitations and restrictions experienced by patients can facilitate the selection of appropriate PROM and targeting of treatment.

Therefore, the aims of this review were (i) to identify the symptoms, impairments, activity limitations and participation restrictions in people with WAD and (ii) to aggregate the quantitative and qualitative evidence to construct a symptom profile for people with WAD. The International Classification of Functioning, Disability and Health (ICF) provided a framework for this review (International Classification of Functioning and Health, 2008), guiding symptom identification, and finally assisting in formulating symptom profile. Although there are indications that the ICF system is dominated by a medical perspective rather than a biopsychosocial perspective (Heerkens et al., 2018), it has been shown to be a valuable tool for describing and comparing information and results collected from quantitative and qualitative studies (Fayed et al., 2011).

2. Methods

A mixed-method systematic review with a convergent integrated approach was conducted following the Joanna Briggs Institute (JBI) methodological approach (Stern et al., 2020). The review protocol was registered in the PROSPERO database (registration number: CRD42020207515). The reporting of the systematic literature review was based on that recommended by the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyzes) statement (Moher et al., 2009).

2.1. Search strategy

The data search was performed using PubMed, Embase, PsycINFO, CINAHL, and Scopus databases published from inception to the date of search, September 26th, 2020. The search was updated on March 23rd, 2023. With the support of the university librarian, a strategy was developed and adapted for each database, which included Medical Subject Headings and free-text terms. The search phrase used three groups of keywords: neck trauma, symptoms and impairments, and assessment tools. The complete search strategy is shown in Appendix 1. The reference lists of identified studies were manually screened for additional studies.

2.2. Article selection

A two-step screening process was used to identify the studies. Initially, the two evaluators (NS and SL) independently reviewed the titles and abstracts of the studies and graded the studies as 'potentially relevant' or 'insignificant'. Then, in the second phase, the evaluators independently performed a full-text review of the studies identified as 'potentially relevant' and graded them as 'relevant' or 'insignificant'. In both phases, the evaluators met after the review to resolve disagreements about the eligibility of the studies. A third reviewer (JT) made the decision if no consensus was found.

An article was included if it met the following criteria: 1) a full-text original study; 2) published in English in a scientific peer-reviewed journal; 3) including adult (≥18 years old) people with WAD; and 4) the symptoms, disabilities, functional and participation limitations, or environmental factors affecting them were reported. The exclusion criteria were: 1) recommendations, comments, dissertations, reports, conference proceedings, books or book articles, or lecture materials; 2) literature reviews; and 3) studies including patients with both traumatic and non-traumatic neck pain where the results of the patient groups were not segregated.

Inter-rater reliability between evaluators' gradings ('relevant' or 'insignificant') was calculated using percentages of agreement and Cohen Kappa with a 95% confidence interval (CI) at both screening stages. Kappa values above 0.81 have been proposed as almost perfect; 0.61–0.8 as substantial; 0.41–0.6 as moderate; 0.21–0.4 as fair; and below 0.2 as poor (Sim and Wright 2005). In addition, we evaluated inter-rater disagreement with McNemar's test. A significance level of 0.05 (two-tailed) was used for the difference in rater disagreement. All statistical analyses were performed by the fourth reviewer (EL) with SAS software, Version 9.4 of the SAS System for Windows (SAS Institute Inc., Cary, NC, USA).

2.3. Assessing the risk of bias

To evaluate the quality of the studies, the Critical Appraisal Skills Programme (CASP) checklist was chosen for qualitative studies (Critical Appraisal Skills Programme, 2023a) because it has been extensively used in previous qualitative reviews, especially in low-back pain but also in WAD (Holopainen et al., 2020; Söderlund et al., 2018). The CASP checklists consist of three main sections: evaluating the validity of the results, presenting the results, and evaluating the application of the results in practice. The statements of each section are graded as yes/can't tell/no. The included studies were evaluated independently, and disagreements were resolved by discussion. However, all the articles were included in the study regardless of their quality according to the CASP because this review aimed to gain a broad view of the symptom profile of patients with WAD. Furthermore, no clear guidelines exist for excluding qualitative studies from a review.

2.4. Data extraction

Two reviewers (NS and SL) extracted the data from the included studies. The same information was extracted from each study: description of the study population, sex, age, Quebec Task Force (QTF) classification, duration of symptoms, the aim of the study, the methods of subject selections and data collection and sample size. Furthermore, all the results reported in the studies related to symptoms, disabilities, functional and participation limitations, and environmental factors affecting them were extracted.

2.5. Data synthesis and analysis

To identify all possible data, the principles of thematic analysis were used as described by Thomas and Harden (2008). In the first step, two reviewers (NS and SL) extracted data from the included studies and transferred them into a Microsoft Excel spreadsheet. The data were processed separately depending on the research method and the parameters. However, if the studies' data could not be linked with a single symptom, function, or limitation, such as the total scores or subscores of the outcome measure, or only expressed deficiencies in the anatomical

parts of the body, it was excluded. For example, the results of the NDI questionnaire were included if they were presented for each question separately but were excluded if the study presented only the total disability score.

Then, both quantitative and qualitative data were divided and coded according to the ICF main components and smaller domains, facilitating familiarization with the data and guiding symptom identification and later data comparison. If the data presented in the study did not fit into any ICF domains, a new domain and code were formed.

After allocation, the codes were compared to find similarities and differences and pooled or qualitized where appropriate. Qualitizing involved converting quantitative data into textual descriptions to facilitate integration with qualitative data (Lizarondo et al., 2022), such as describing the sample with word categories based on descriptive statistics (means or percentage). Finally, the codes were grouped to form a set of themes describing the symptom profile of people with WAD. The coding, pooling, qualitizing and development of themes were done by the first reviewer (NS), checked by the second reviewer (SL), and refined

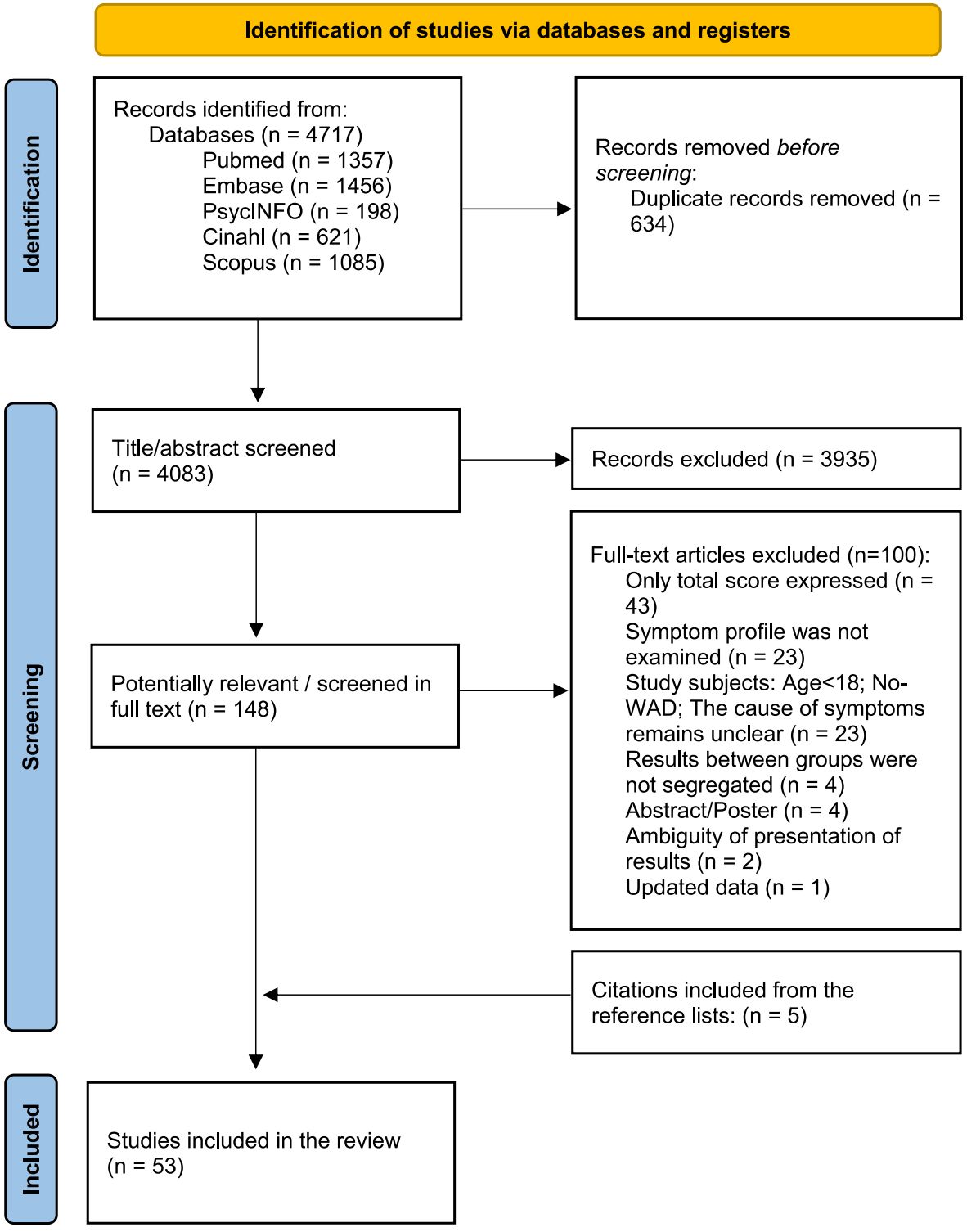

Fig. 1. Prisma flow chart demonstrating the screening process.

through discussion. After the discussion, the data were analyzed, and the themes were described.

3. Results

3.1. Deviations from protocol

One change was made to the initial protocol published on Prospero. The original protocol specified that the quality of the studies was assessed using the CASP checklist for qualitative studies. Since the review was expected to include other study designs as well, the CASP checklist was selected according to the research method of the study included in the review. CASP was used because it has developed several methodological assessment tools (Zeng et al., 2015) with consistent use principles.

3.2. Study selection

The literature search retrieved 4717 studies, 634 of which were duplicates. The screening process is described in Fig. 1. The review included 53 studies, of which 46 were cohort studies (Anstey et al., 2016; Borchgrevink et al., 1996; Bring et al., 2012; Brison et al., 2000; Buitenhuis et al., 2014; Cancelliere et al., 2021; Carroll et al., 2006, 2007; Côté et al., 2001; Crutebo et al., 2010; Ferrari et al., 2005; Häggman-Henrikson et al., 2011; Hagström and Carlsson 1996; Haldorsen et al., 2003; Hincapié et al., 2010; Holm et al., 2007; Hoving et al., 2003; Ihlebæk et al., 2009; Kasch et al., 2003; Kasch and Jensen 2019; Klobas et al., 2004; Kristjansson 2004; Kumagai et al., 2022; Lampa et al., 2019; Mayou and Bryant, 1994, 1996; Obelieniene et al., 1999; Pajediene et al., 2015; Radanov et al., 1993, 2011; Robinson et al., 2007; Schmitt et al., 2013; Severinsson et al., 2010; Stenneberg et al., 2022; Sterling and Pedler 2008; Sterner et al., 2002; Stone et al., 2021; Stupar et al., 2015; Styrke et al., 2014; Sue See and Treleaven 2014; Takasaki et al., 2011, 2012; Valenza et al., 2012; Verhagen et al., 2011; Wallis et al., 1996; Wenzel et al., 2009), three case control studies (Anarte-Lazo et al., 2022; Häggman-Henrikson et al., 2016; Pereira et al., 2008) and four qualitative studies (Juuso et al., 2020; Krohne and Ihlebaek 2010; Peolsson et al., 2021; Silva Guerrero et al., 2020).

In the first screening phase, the Cohen's kappa (95% CI) for inter-rater reliability was 0.53 (0.47–0.6), and the inter-rater agreement was 96,4%. In the second phase, the Cohen's kappa was 0.52 (95% CI 0.39–0.66), and the inter-rater agreement was 76.5%. There were significant differences ($p < 0.01$) in the inter-rater disagreement in both phases.

3.3. Characteristics of included studies

A summary of the included studies is presented in Table 1. The sample size of the included studies was 102 943 (from 7 to 52 993), of which 43 415 had WAD. The majority (62%) of the subjects with WAD were women. The duration of subjects' symptoms could be classified in 21 studies as acute (<3 months after the whiplash injury) and in 22 studies as chronic (>3 months after the whiplash injury). Ten studies could not be grouped by symptom duration due to wide variability in subjects' symptom duration or lack of reporting.

3.4. Methodological quality

Since the review included cohort, case-control and qualitative studies, a CASP checklist suitable for each research method was used to evaluate the quality (Critical Appraisal Skills Programme, 2023a, 2023b, 2023c). For every included study, the unmet CASP criteria and a short description of the reasons are presented in Table 1. Eleven studies met all the methodological criteria. The most common unmet or unclear methodological criteria were related to the CAPS checklist's first main section, the validity of the results. In half of the studies, there was ambiguity in the recruitment of patients. WAD was often self-reported or attached to an accident or insurance claim without a review or evaluation by a healthcare professional.

Furthermore, just under half of the studies used validated instruments or methods as outcome measures, or general questionnaires, the content of which was reported. Nearly 60% of the studies did not identify all the confounding factors. In addition to the recruitment of patients and the outcome measures used, these ambiguities were related to the sample size of the studies and the demographic factors of the subjects. For example, the adequacy of the sample size was often unclear, and the duration of the subjects' symptoms and the time after the accident varied greatly. Due to the unmet criteria related to the validity of the results, the criterion of the third main section of the CAPS checklists, the applicability of the results to the local population, often remained unclear.

3.5. Results of syntheses

The analysis process identified a total of 309 different symptoms, impairments, activity limitations and participation restrictions, which could be divided into three key themes: 1) the prevalence of symptoms, impairments, or limitations; 2) the severity of symptoms and effect of symptoms on functioning, activity and participation; and 3) the effects of environmental factors on the symptom profile. The prevalence of symptoms was evaluated in 41 quantitative studies (Appendix 2). The effect of symptoms on functioning, activity and participation was assessed with 48 instruments and four qualitative syntheses (Appendix 3). However, only seven studies reported questionnaire results separately for each question instead of the total score. The questionnaires used in these seven studies were the NDI, Disabilities of the Arm, Shoulder, and Hand questionnaire (DASH), WDQ, Northwick Park Neck Pain Questionnaire (NPQ), Problem elicitation technique (PET), Rivermead post-concussion symptoms questionnaire (RPCSQ), and Pittsburgh sleep quality index (PSQI). Still, the RPCSQ was the only instrument used in more than one study. In addition, 14 studies used the Visual Analogue Scale (VAS) or Numeric Rating scale (NRS) to measure pain intensity in different body parts (Appendix 3). The effects of environmental factors on the symptom profile were only reported in four qualitative studies (Appendix 4).

3.5.1. Prevalence of symptoms

Due to the extensive list of symptoms, a statistical analysis was performed only of symptoms, impairments or limitations whose prevalence was evaluated in at least five separate studies. In the analysis, the number of studies was emphasized instead of the sample size, as in random-effect modelling in meta-analyses (Guolo and Varin 2017; Jackson and Turner, 2017; Seide et al., 2019), because this gives more information about the distribution of the data and, therefore minimizes the bias caused by a single study with a large sample size.

The prevalence of each symptom, impairment, or limitation was calculated from the number of patients in relation to the total sample size in the studies investigating the prevalence of the symptom. If the study reported the results as percentages, they were converted to numbers for analysis. If the prevalence of the same symptom was reported at several time points in a study, e.g., in a prognostic study, the first time point was used. The results of prevalence were expressed as a percentage.

After analysis, a total of 29 symptoms, impairments, and activity and participation limitations were found, of which 25 were included in problems in body functions. Overall, 89% of people with WAD reported neck pain, 75% had shoulder pain, 70% reported headache, and almost 60% had lower and upper back pain. The most common impairments were related to neck movements (72%) and sleeping (66%). Just under half of the subjects experienced fatigue (49%) and irritability (47%). Only four activity and participation limitations were included in the analysis. Among people with WAD, 41% experienced problems with

Table 1
Summary of the included studies. 3Q/TMD = Screening questions of jaw pain and dysfunction; AD = Ankle disorder; C = Control; CES-D = Center for epidemiology studies depression scale; CFQ = Cognitive Failure questionnaire; CPPT = Chronic pain patients with trauma; DASH = Disability of the Arm, Shoulder and Hand Questionnaire; DHI = Dysphagia Handicap Index; DHQ = Driving Habits Questionnaire; DRI = Disability Rating Index; DS = Jaw pain-related disability score; EuroQol = General health; F = Female; GHQ-28 = General Health Questionnaire-28; HADS = Hospital Anxiety and Depression Scale; HSCL-25 = Psychological distress; ICD-10 = International Classification of Diseases; IES = Impact of Events Scale; IES-R = Impact of Event Scale-Revised; IONP = Insidious onset neck pain; JDC = Jaw liability checklist; Lisat-11 = Life satisfaction questionnaire; M = Male; MACL = The Mood Adjective Check List; MACTAR = McMaster Toronto Arthritis patient preference disability questionnaire; MBHI = Millon Behavioral Health Inventory; MPI = Multidimensional Pain Inventory; mRPQ = Modified Rivermead post-concussion symptom questionnaire; MVC = Motor vehicle collision; n = Study population; NBQ = Neck Bournemouth Questionnaire; NDI = Neck Disability Index; NMQ = Nordic Musculoskeletal Questionnaire; NPDI = Neck Pain Driving Index; NPQ = Nortwick park neck pain questionnaire; NRS = Numeric rating scale; NSNP = Non-spesific neck pain; PASS = Pain Anxiety Symptom Scale; PCS = Pain Catastrophizing Scale; PET = Problem Elicitation Technique; PFActS = Pictorial Fear of Activities Scale; PMI = Vanderbilt Pain Management Inventory; PRIME-MD = Primary care evaluation of mental disorders; PSFS = Patient Specific Functional Scale; PSQI = Pittsburg Sleep Quality index; QTFQ = Quebec Task Force Questionnaire; QTF = Quebec task force; RHFUQ = Rivermead Head injury Follow Up Questionnaire; RPQ = Rivermead Post-concussion Symptom Questionnaire; SCL-90-R = Symptom Checklist-90-Revised; SF-36 = 36-item Short form survey; SHC = Subjective health complaints inventory; S-LANSS = Leeds Assessment of Neuropathic Symptoms and Signs pain scale; STAI = The State-Trait Anxiety Inventory; STMS = Short test of mental status; TMD = Tempomandibular disorder; TSK = Tampa Scale of Kinesiophobia; WAD = Whiplash associated disorder; WAD-DCA = WAD - daily coping assessment; VAS = Visual Analogue Scale; WDQ = Whiplash Disability Questionnaire.

Citation	Primary aim	Participants	Classification	Symptom duration	Instruments	Summary of results	CASP-criteria unmet
Quantitative studies							
Cohort studies							
Anstey et al. (2016)	To identify whether patients who have had neck pain and a history of whiplash are different from those who have neck pain and no history of whiplash.	Total n = 2578 (f1573, m1005); WAD n = 488 (f332, m256), NSNP n = 2090 (f1233, m857)	The presence of WAD according to responding to the question: "Has the patient been exposed to whiplash trauma" (Whiplash trauma is here defined as an acceleration/ deceleration of the cervical spine. It is not restricted to movement in a certain plane or to certain mishaps).	Chronic	NRS (Neck pain), neck pain frequency (number of days/ week), previous neck pain, NDI, EuroQol, Anxiety (NRS), PRIME-MD (two questions of depression), NRS (belief about pain becoming persistent), dizziness (yes/no), Memory difficulties (yes/no), morning stiffness (yes/no)	Patients with WAD were statistically different from patients without WAD for almost all characteristics investigated (especially dizziness 67% vs. 45%, memory difficulties 68% vs. 36%) except for the frequency of neck pain.	2: There was ambiguity in patient recruitment.
Borchgrevink et al. (1996)	To study the extent of sick leave and the number of claims; to study subjective symptoms, experiences of health and quality of life.	Total n = 426 (f252, m174); WAD n = 426 (f252, m174)	Patients registered with neck strain injuries from car collisions.	Chronic	Questionnaire: questions about the accident, employment status and symptoms.	27% had been reported sick during the period after the car accident and 5% had claimed health insurance. 58% reported sustained symptoms linked to the accident.	4, 5a: The questionnaires had not been clarified, the demographic data of the subjects were not reported, and time elapsed since the accident was not considered.
Bring et al. (2012)	To describe the most stressful daily situation or event repotted by individuals with acute WAD.	Total n = 51 (f35, m16); WAD n = 51 (f35, m16)	Acute WAD was classified as WAD grade I-III in emergency wards.	Acute	WAD-DCA	The most disabling stressor was reported in the category of physical symptoms, while the most threatening stressor was reported in the categories driving. The most bothersome stressor was related to self-care and feeling/cognition.	4, 5a, 9, 10, 11: The validated questionnaire had been modified, only half filled out all seven-day questionnaires, the subjects had a wide variety of symptoms, the adequacy of the sample size remained unclear, and the results did not fit with other research material on the topic.
Brison et al. (2000)	The natural course of symptoms among individuals involved in rear-end MVCs, from the acute stages of injury through to up to two years post-injury.	Total n = 353 (f224, m129); WAD n = 353 (f224, m129)	WAD was defined: Involvement in rear-end motor vehicle collision and at least the occurrence of neck, upper back, or shoulder pain.	Acute	Total design method approach for telephone survey.	61% experienced WAD and commonly associated symptoms accompanying WAD: low back pain, neck stiffness, headache, upper extremity numbness/weakness and visual complaints.	4: The overall design method approach was not clear.
Buitenhuis et al. (2014)	To analyze the consequences of neck pain after motor vehicle accidents in terms of disability for	Total n = 879 (f539, m340); WAD n = 879 (f539, m340)	Victims of car accidents, who had initiated compensation claim procedure at an	Acute	Questionnaire concerning the accident and injuries, and questions regarding	A total of 58,8% of the population with neck complaints studied was work-	2, 4, 5a, 5b, 10: Study related to insurance claim, the subjects were selected based on self-reporting, a

(*continued on next page*)

Table 1 (*continued*)

Citation	Primary aim	Participants	Classification	Symptom duration	Instruments	Summary of results	CASP-criteria unmet
	work and the relationship this has with symptoms and work-related factors.		insurance company and who had presented themselves with neck complain.		complaints, work, and disability.	disabled after the accident.	superficial and non-validated questionnaire was used.
Cancelliere et al. (2021)	Objective was to develop a prediction model for self- rated overall nonrecovery from traffic injuries six months post-collision in adults with incident traffic injuries including post-traumatic headache.	Total WAD n = 4541, Cohort 1 n = 4162; Cohort 2 n = 379; Included WAD n = 3384, Cohort 1 n = 3091 (f2158, m933); Cohort 2 n = 293 (f191, m102)	Included all adults who made a bodily injury claim or were treated by a registered health professional after motor vehicle injury.	Acute	Self-report questionnaire using validated measures wherever possible: NRS; overall general health, CES-D. Follow-up data: computer-assisted telephone interview, self-reported questionnaire.	The most common impairments caused by MVC were neck pain, stiffness in neck, sleeping problems, mid back pain, low back pain, and symptoms in arms or hands.	2, 5a, 10: Study related to insurance claim.
Carroll et al. (2006)	To report frequency, time of onset, and course of depressive symptoms after whiplash.	Total n = 5845 (f3871, m1974); WAD n = 5845 (f3871, m1974)	Whiplash was defined: did the accident cause neck or shoulder pain.	Acute	Insurance application, NRS, CES-D, NRS, structured interview.	42.3% of the subjects developed depressive symptoms within 6 weeks of the injury.	2, 4, 5a, 10: The insurance application or structured interview had not been clarified, study related to insurance claim, there was ambiguity in patient recruitment, and the considerable variation in the duration of symptoms and time elapsed since the accident was not considered.
Carroll et al. (2007)	To identify personal characteristics, crash-related factors and postinjury symptoms associated with the onset of reduced or painful jaw movement in claimants with WADs.	Total n = 7124 (f4269, m2855); WAD n = 7124 (f4269, m2855)	Self-reported: 1) "Did the accident cause neck or shoulder pain?"; and 2) "Have you felt neck or shoulder pain or have you felt reduced or painful neck movement since the accident?"; and/or 3) "Have you felt reduced or painful neck movement since the accident.	Acute	Questionnaire about the presence of reduced and/or painful jaw movement after collision, VAS.	The prevalence of painful jaw movement was 14.9% and it was higher in subjects with WAD than in those without WAD.	2, 4, 5a, 10: Study related to insurance claim, the subjects were selected based on self-reporting, and a non-validated questionnaire was used.
Côté et al. (2001)	To prospectively quantify the strength of the association between accepted health indicators of recovery and time-to-claim-closure in a cohort of claimants with whiplash injuries.	Total n = 5398 (f3235, m2161); WAD n = 5398 (f3235, m2161)	Self-reported: "Did the accident cause neck/shoulder pain?" and "Have you felt neck/ shoulder or reduced/ painful neck movement pain since the accident?"	Acute/ chronic	VAS, SF-36, CES-D.	Higher pain intensity, poorer physical function and the presence of depressive symptomatology was related to slower claim-closure rates.	2, 5a, 10: Study related to insurance claim, and the subjects were selected based on self-reporting.
Crutebo et al. (2010)	To describe the prevalence and course of commonly reported whiplash-related symptoms and to describe the prevalence of self-reported "poor" psychological health.	Total n = 1005 (f599, m406); WAD n = 1005 (f599, m406)	Victims of car accidents who had initiated compensation claim procedure at an insurance company and, and who responded "yes" to either of the 2 following questions: "Do you have or have you had pain/ache in the neck due to the accident?" or "Do you have or have you had reduced neck	Acute	Questionnaire about the symptoms (yes/no), severity of symptoms with NRS or 5-point Likert-scale, Impact event scale, HADS.	The most common symptoms at baseline after the accident were reduced cervical range of motion (m83.9%, f82.2%), headache (m61.0%, f69.3%), and low back pain (m35.9%, f36.1%). Baseline prevalence of depression was around 5% (m and f), whereas post-traumatic stress and anxiety were more	2, 4, 5a, 10: Study related to insurance claim, the subjects were selected based on self-reporting, and a non-validated questionnaire was used.

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Table 1 (*continued*)

Citation	Primary aim	Participants	Classification	Symptom duration	Instruments	Summary of results	CASP-criteria unmet
			movement that you relate to the accident?".			common in women (19.7% and 11.7%, respectively) compared to men (13.2% and 8.6%).	
Ferrari et al. (2005)	To describe, using a large population-based cohort, the clinical spectrum of initial symptom expression and health related measures of WAD.	Total n = 7642 (f4533, m2926); WAD n = 7642 (f4533, m2926)	Individuals who sustained a traffic injury.	Acute	Standard questionnaire of the insurance company, SF-36.	For most subjects, neck pain was only one of many diffuse and intense symptoms. The range of symptoms, including fatigue, dizziness, paraesthesia, headache, spinal pain, nausea, and jaw pain, could be interpreted as a systemic disorder.	2, 4, 5a, 10: Study related to insurance claim, the subjects were selected based on self-reporting, a non-validated questionnaire was used.
Hagström and Carlsson, 1996	To describe and evaluate symptoms and signs in patients with prolonged disability after a whiplash injury.	Total n = 60 (f42, m18); WAD n = 30 (f22, m8); C n = 30 (f20, m10)	Diagnosed whiplash.	Acute/ chronic	VAS, Pain characteristics (selection of symbols), Pain drawing, MACL.	All patients had pain in the neck, 17–33% had headache, 6–17% had pain in various regions of the arms, and 43% suffered from constant pain while 57% had pain-free periods.	1, 2, 5a, 5b, 9, 10: The purpose of the study was unfocused and there was no information about the hypotheses, there was ambiguity in patient recruitment, intra-group differences were not taken into consideration, and the adequacy of the sample size remained unclear.
Haldorsen et al. (2003)	To compare STMS between groups.	Total n = 90 (f52, m38); WAD n = 40 (f25, m15); C n = 50 (f27, m23)	Symptoms after acceleration-deceleration injury.	Chronic	STMS, mRPQ.	The most frequent symptoms were neck pain, headache, "taking longer to think," forgetfulness, poor concentration, and fatigue.	2, 5a, 9, 10: There was ambiguity in patient recruitment, and the adequacy of the sample size remained unclear.
Hincapié et al. (2010)	To determine the prevalence of bodily pain after traffic collisions, and to identify patterns of pain that account for most of the variance in pain localization after traffic injury	Total n = 6481 (f3897, m2581); WAD n = 6481 (f3897, m2581)	Who made an insurance claim for an injury or received insured care for an injury.	Acute	Complete a pain drawing on a body diagram.	Incidence of neck pain was 86%, head pain 72% and lumbar back pain 60%. 95% of the claimants reported some pain within the posterior trunk region, and only 0.4% reported only posterior neck pain only.	2, 10: Study related to insurance claim, and the subjects were selected based on self-reporting.
Holm et al. (2007)	To investigate the incidence and course of WP in subjects with WAD with localized pain after MVC; and (2) to investigate factors associated with the onset of subsequent WP.	Total n = 266 (f157, m109); WAD 266 (f157, m109)	All car occupants who filed an insurance claim or were treated for a traffic injury and reported neck pain after the MVC.	Acute	Pain drawings, Questionnaire (not specified).	The prevalence of subjects classified as cases of WP was 50–60% at different follow-ups.	2, 4, 5, 9, 10: Study related to insurance claim, the subjects were selected based on self-reporting, and a not specified questionnaire was used.
Hoving et al. (2003)	To assess the content and construct validity of the NDI and NPQ as measures of disability in WAD.	Total n = 71 (f59, m12); WAD n = 71 (f59, m13)	Diagnosed WAD according to QTF classification.	Acute/ chronic	VAS (day, night), severity of symptoms (0–5), NDI, NPQ, PET.	Mean NDI, NPQ, and PET scores were 40.7, 38.7, and 160.2, respectively. Problems most commonly identified were work for wages (52.1%), fatigued during the day (50.7%), participation in sports (47.9%), depression (43.7%),	–

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Table 1 (*continued*)

Citation	Primary aim	Participants	Classification	Symptom duration	Instruments	Summary of results	CASP-criteria unmet
						drive a car (43.7%), socialize with friends (33.8%), sleep through the night (31.0%), frustration (31.0%), and anger (28.2%).	
Häggman-Henrikson et al. (2011)	Investigate the frequency of jaw-face pain, pain in other body regions and frequency of other symptoms typical for chronic WAD.	Total n = 87 (f49, m38); WAD n = 32 (f22, m10), C n = 55 (f27, m28)	Diagnosed and classified by physician as WAD class II or III according to the QTF classification.	Chronic	Questionnaire containing 22 items about frequency of pain in different body regions, frequency of symptoms in the jaw-face-head region, and frequency of general symptoms (0 = No, never; 1 = Yes, seldom, every year; 2 = Yes, often, every month; 3 = Yes, very often, every week; and 4 = Yes, always, every day).	88% of the patients with WAD reported frequent pain in the jaw-face, in addition to frequent pain in the neck (100%), shoulders (94%), head (90%) and back (72%). The patients with WAD also reported stiffness and numbness in the jaw-face region, and frequent general symptoms such as balance problems, stress, and sleep disturbances.	2, 4, 5a, 9, 10, 11: The selection of test subjects, non-validated questionnaire (selection of subjects) and adequacy of sample size remained unclear.
Ihlebæk et al. (2009)	To investigate subjective health complaints in patients with chronic WAD and to identify physical measures and psychological and collision factors that might be associated with high levels of comorbidity.	Total n = 1185 (f632, m553); WAD n = 171 (f115, m56); C n = 1014 (f517, m497)	Symptoms according to WAD I-II.	Chronic	Quality of life (1–10), optimism concerning their neck pain (yes/no), SHC, modified Rolland & Morris disability, sickness absence, HSCL-25.	The patients with chronic WAD reported higher number of subjective health complaints than the general population.	4, 5a: A non-validated questionnaire was used.
Kasch et al. (2003)	The aim was to determine whether whiplash syndrome is a specific traumatic condition producing particular sequelae confined to the impact on the neck or whether similar symptoms also occur in other traumatic conditions.	Total n = 181; WAD n = 141 (f74, m67; AD = n40	Exposure to car accident with a rear collision and visit to the local emergency unit within the first 2 days after trauma with complaints of neck pain or headache.	Acute/ Chronic	Interviews and examination; VAS; MBHI.	Overall pain intensity (headache, neck pain, shoulder-arm pain, and low back pain) was similar in patients with WAD and AD. Neck pain, headache, shoulder-arm pain, and low back pain were more intense and frequent in the WAD group than in the AD group. After 1 year, all AD had returned to either work or to usual daily activities, whereas 12% of WAD patients still had difficulty carrying out their job or were on long-term sick leave.	5b, 9, 10: There was ambiguity about the effects of differences in study group sizes.
Kasch et al. (2019)	The aim of this study was to apply The Rivermead Head Injury Questionnaire in a group of neck-injured patients.	Total n = 143 (f75, m68); WAD 143 (f75, m68)	Patients admitted to emergency departments, being exposed to a whiplash injury during rear-end collision motor vehicle accidents within 48 h after a car accident.	Acute/ Chronic	RHFUQ.	Non-recovered patients reported more neck pain and global pain after 1 week and 6 months and higher PCS symptom score after 1 week and 6 months. At 1week, 8 of 10 items from RHFUQ reached higher scores among non-recovered and 10 of	–

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Table 1 (*continued*)

Citation	Primary aim	Participants	Classification	Symptom duration	Instruments	Summary of results	CASP-criteria unmet
						10 items after 6 months post-injury.	
Klobas et al. (2004)	To compare the prevalence of symptoms and clinical signs of TMD between groups.	Total n = 120 (f72, m48); WAD n = 54 (f32, m22); C n = 66 (f40, m26)	Diagnosed WAD.	Chronic	Anamnestic questionnaire.	89% in the WAD-group had severe symptoms of TMD according to Helkimos anamnestic index of dysfunction.	4, 5a, 9, 10: There was no information about the validity and reliability of the used questionnaire, and the adequacy of the sample size remained unclear.
Kristjansson, 2004	To determine whether symptom characteristics in women diagnosed with chronic WAD differ from those in women diagnosed with chronic IONP and whether the persistence of symptoms differs between the two group.	Total n = 80 (f80, m0); WAD n = 41 (f41, m0); IONP n = 39 (f39, m0)	Diagnosed with WAD I or II according to QTF classification by a doctor and physiotherapist.	Chronic	NMQ, Standardized telephone interview.	Neck pain, shoulder pain, self-reported activity-related complaints and specific complaints, like numbness in the arms, memory loss and poor concentration, were significantly more prevalent and severe in the WAD-group as compared to the NSNP-group.	4, 5a, 9, 10: The valid questionnaire had been modified, the content of the interview had not been reported, the adequacy of the sample size remained unclear, the subjects were only women, and the subjects had a large variation in the duration of symptoms and the time elapsed since the accident.
Kumagai et al., 2022	The study aimed to investigate the prevalence of whiplash injuries among participants from a Japanese community; the association between whiplash injuries and QOL was determined.	Total 1140 (f688, m 452); WAD n = 101 (f66, m35)	Questionnaires about whether they had ever suffered a whiplash injury.	Not reported	Questionnaires about education, medical history, lifestyle, and symptoms; VAS; SF36.	The prevalence of neck pain in men and women were significantly higher in the WAD group (m40.0%, f40.9%) than in the non-WAD group (m15.5%, f19.8%); The VAS of neck pain and neck-shoulder stiffness, and prevalence of symptom frequency in women were significantly higher in the WAD group than in the non-WAD group.	2, 4, 5: There was ambiguity in the recruitment of patients and used questionnaires, and the subjects were classified based on self-reporting.
Lampa et al. (2019)	To evaluate the course of orofacial pain and jaw disability in relation to neck pain, neck disability, and psychosocial factors at the acute and chronic stages of whiplash trauma.	Total n = 292 (f172, m120); WAD n = 176 (f104, m72); C n = 116 (f68, m48)	Diagnosed with neck distortion (ICD-10 S13.4) by a physician.	Acute	NRS (neck pain/jaw pain), NDI, JDC, DS, 3Q/TMD, Axis II.	Compared to controls, the WAD group had higher prevalence of jaw pain (p = 0,022 and jaw pain on function (p = 0,004). A majority (68%) of subjects in WAD group with pain in the jaw region in the acute stage also reported jaw pain at the follow-up.	–
Mayou and Bryant 1994	Not reported.	Total n = 194 (f60, m134); WAD n = 63 (f36, m27); T n = 131 (f24, m107)	Patients who suffered an accident were recruited from the accident department of the hospital.	Chronic	Standard questionnaire.	Considerable changes in vehicle-driving behaviour and attitudes to travel were reported.	1, 4, 5a, 5b, 9, 10, 11: The purpose of the study was not clear, and the standard questionnaire, interview or data collection had not been clarified.
Mayou and Bryant, 1996	To provide information on outcome after whiplash, and factors which predict physical psychological and social outcome in long term.	Total n = 63 (f36, m27); WAD n = 63 (f36, m27)	Patients who diagnosed (identified by daily review of records) as suffering from post-traumatic neck injury were recruited from accident and emergency	Acute	Eysenck Personality inventory, Beck depression inventory, Spielberger anxiety scale, standardized mental-state interview, emergency	There was a wide individual variation in course and outcome; majority of subjects complained of persistent neck symptoms, back and shoulder pain, and headaches.	1, 4, 5b: The purpose of the study was not clear, part of the methods and data collection were unclear, and there was ambiguity in patient recruitment.

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Table 1 (*continued*)

Citation	Primary aim	Participants	Classification	Symptom duration	Instruments	Summary of results	CASP-criteria unmet
			department at the hospital		department notes and police and ambulance reports.		
Obelieniene et al. (1999)	To identify whether or not car accident victims actually develop an acute injury (which is a prerequisite for chronic disability).	Total n = 420 (f58, m362); WAD n = 210 (f29, m181), C n = 210 (f29, m181)	Drivers from rear end accidents, which were recorded to traffic police department.	Acute	A standard self-report questionnaire.	Initial pain was reported by 47% of accident victims; 10% had neck pain alone,18% had neck pain together with headache, and 19% had headache alone.	2, 4, 9, 10: There was ambiguity in patient recruitment, a standard self-reported questionnaire was not clarified, and the results did not fit with other research material on the topic.
Pajediene et al. (2015)	To evaluate the symptomatology by clinical examination and patient-rated questionnaires in patients seeking emergency medical help after motor vehicle collisions.	Total n = 124 (f77, m47); WAD n = 71 (f44, m27), C n = 53 (f33, m20)	Individuals (both drivers and passengers) who sought medical help at the emergency departments and met the selection criteria (there is no information about the criteria).	Acute	VAS, QTFQ, DRI, CFQ, HADS.	93% of the patients developed acute symptoms. The most frequent symptoms found after road traffic accidents were neck or shoulder pain, reduced or painful neck movements including decreased range of motion, multiple subjective symptoms according to QTFQ and significantly reduced pain threshold. Perceived health status was decreased and DRI was increased, while HADS showed a significantly higher risk of developing anxiety.	2, 5a: There was ambiguity in patient recruitment.
Radanov et al. (1993)	To evaluate the predictive relationship between factors which may influence illness behavior and disability in a random sample of recent injured common whiplash patients.	Total n = 97 (f60, m37); WAD n = 97 (f60, m37)	Patients who suffered whiplash injury.	Acute	Interview on patients' history, intensity of neck pain and headache (0–10), vocational activities (3 groups), Freiburgs personality inventory, Well-being scale, The cognitive failures questionnaire.	At 6 months six patients (7%) showed partial or complete disability while 91 patients went back to work at pre-injury levels. However, 26 patients from the latter group at 6 months were still symptomatic.	–
Radanov et al. (2011)	To determine whether the symptoms are specific for late whiplash.	Total n = 100 (f78, m22); WAD n = 50 (f39, m11), CPPT n = 50 (f39, m11)	Symptoms for ≥6 months after the accident (injury to the cervical spine due to an acceleration-deceleration mechanism without loss of consciousness or post-traumatic amnesia).	Chronic	Symptom Checklist 90-Revised.	Headache, trouble concentrating, feeling low in energy, trouble remembering things, and sleep that is restless/disturbed were the 5 most frequent symptoms in both groups alike, reported by >81.4% in the WAD group and >83.3% in the CPPT group.	2, 5a, 9, 10: There was ambiguity in patient recruitment, study related to disability pension, and there was large variation of duration of symptoms and time elapsed since the accident.
Robinson et al. (2007)	To compared people with WADs grades I and II who reported cognitive symptoms to ones who did not report such symptoms.	Total n = 203 (f145, m58); WAD n = 203 (f145, m58)	WAD I or II according to QTF classification confirmed by a physical examination.	Acute	General symptom checklist, NDI, MPI, CES-D, PCS, PASS, PFActS.	32% of the participants reported memory problems, 41% reported problems concentrating, and 54% reported neither problems in memory nor concentration. Participants with cognitive problems scored higher than participants without	2: There was ambiguity in patient recruitment.

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Table 1 (*continued*)

Citation	Primary aim	Participants	Classification	Symptom duration	Instruments	Summary of results	CASP-criteria unmet
						cognitive problems in neck disability, pain severity, depression, pain-related anxiety, fear of neck movements and endorsed more items on the symptom checklist.	
Schmitt et al. (2013)	To develop a condition specific, clinically relevant and useable instrument for patients with WAD that measures activity limitations and participation restrictions.	Total n = 69 (f53, m16); WAD n = 69 (f53, m16),	Patients with WAD (no information about classification).	Chronic	NDI, NBQ, adapted MACTAR.	178 activity limitations or participation restrictions were mentioned. After grouping, rewording, and linking to the ICF, 132 items remained.	2, 5a, 10: There was ambiguity in patient and specialist recruitment. There was large variation in the results.
Severinsson et al. (2010)	To estimate the prevalence of jaw symptoms and signs in adults during the first year after whiplash trauma.	Total n = 146 (f81, m65); WAD n = 146 (f81, m65),	WAD I-III neck problems after traffic accidents, diagnosed and classified by physicians.	Acute	Structured questionnaires, IES-R.	Jaw symptoms were initially reported by three men (5%) and three women (4%), and subsequently developed in eight women (10%) during the following year.	4: Information on the used structured questionnaire was not reported.
Stenneberg et al., 2022	Aim was to compare clinical characteristics in terms of type and severity of impairments, disability, and psychological factors between matched groups of patients with WAD, those with NTNP, and pain-free individuals in primary physiotherapy care.	Total n = 840 (f620, m220); WAD n = 168 (f124, m44); NTNP n = 336 (f248, m88); C n = 336 (f248, m88)	WAD grade I or II (traumatic was defined as symptoms caused by a motor vehicle collision or other mishap with an acceleration–deceleration mechanism) or NTNP grade I or II as primary complaint. Patients were checked by physiotherapists.	Acute/ Chronic	Physical factors, activity limitations, participation restrictions, and psychological factors commonly gathered in physiotherapy practice according to ICF; NPRS; Global levels of activity limitations and participation restrictions were both assessed on a 5-point Likert scale; NDI, PSFS.	Patients with WAD reported a significantly higher pain score, wider distribution of their neck pain, more low back pain, and scored significantly higher on activity limitations, participation restrictions, and disability than those with NTNP.	–
Sterling and Pedler, 2008	The aims of this study were: (1) to evaluate the presence of a neuropathic pain component in an acute whiplash cohort, (2) to investigate relationships between S-LANSS scores and pain and disability, psychological distress and sensory features of acute whiplash and (3) to determine relationships of S-LANSS items and cold pain threshold in acute whiplash.	Total n = 85 (f54, m31); WAD n = 85 (f54, m31)	Individuals reporting neck pain as a result of a motor vehicle crash. The whiplash subjects were recruited via hospital accident and emergency departments, primary care practices and from advertisement. They were eligible if they met the Quebec Task Force Classification of WAD I, II or III.	Acute	NDI; S-LANSS; GHQ-28.	Thirty-four percent demonstrated a predominantly neuropathic pain component.	–
Sterner et al. (2002)	To compare aspects of disability and perceived global situation in the patient group with chronic WAD with the healthy group of subjects.	Total n = 87 (f49, m38); WAD n = 32 (f22, m10), C n = 55 (f27, m28)	Chronic WAD (no information about classification).	Chronic	Questions concerning pain localization (no never; no seldom; yes occasionally; yes often), pain characteristics and pain intensity (VAS), Activity preference 0–10	Significantly lower levels of activity preferences were noted for 3 out of 5 indices in the WAD group for females. Satisfaction with life as a whole, physical and psychological health was	4, 9, 10: Information about the validity and reliability of the used questionnaires were not reported, and the adequacy of the sample size remained unclear.

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Citation	Primary aim	Participants	Classification	Symptom duration	Instruments	Summary of results	CASP-criteria unmet
					(manual activities, physical activities, social activities, activities of daily life), Life satisfaction (1–6).	significant lower in the WAD group.	
Stone et al. (2021)	Aimed to investigate the percent prevalence of self-reported dysphagia post-whiplash and to explore changes in self-reported dysphagia over time and the relationship between dysphagia and both recovery status and changes in pharyngeal volume on MRI.	Total n = 60 (f11, m49); WAD n = 60 (f11, m49)	Acutely injured adults recruited at the time of presentation to an urban emergency medicine department with Level 1 trauma designation following MVC.	Acute/ Chronic	NDI, TSK, PMI, CES-D 10, IES, DHI.	A total of 30 (50%) had total scores which fell outside the normal range of self-reported dysphagia (≥3 on the DHI) at some points within 12 months of injury.	–
Stupar et al. (2015)	To determine the WDQ's structural and contract validity in individuals with acute WAD.	Total n = 130 (f91, m39); WAD n = 130 (f91, m39)	Diagnosed WAD I, II or III.	Acute	NRS, WDQ, NDI, NBQ, CES-D, SF-36, Self-rated recovery.	Mean WDQ score on symptoms: Pain 5.7; fatigue 5.4; and disability: sporting activities 6.3, work/ home/study duties 4.8, and sleep 4.8.	–
Styrke et al. (2014)	To study neck pain and other symptoms, disability and life satisfaction.	Total n = 755; WAD n = 186 (f100, m86); C n = 569 (f179, m282, ?108)	ICD-10 S13.4, WAD I-III.	Chronic	VAS, RPQ, RHFUQ, Lisat-11	Prevalence of symptoms: fatigue (41%), poor memory (39%), and headache (37%); Prevalence of disability: Sustain previous workload (44%) and fatigue at work (43%)	–
Sue See and Treleaven, 2014	To identify the upper limb symptoms and the degree and nature of upper limb function and impairments in patients with persistent WAD.	Total n = 48 (f39, m9); WAD n = 24 (f21, m3); C n = 24 (f18, m6)	WAD, included if presented with persistent symptoms (no further description).	Chronic	PSFS, NDI, DASH, VAS.	Upper limb symptoms and functional deficits are prevalent in persistent WAD. All individual item scores on the DASH, except one, were significantly higher in the WAD group and the DASH moderately correlated to pain, NDI and PSFS.	2, 9, 10: There was ambiguity in patient recruitment, and the adequacy of the sample size remained unclear.
Takasaki et al. (2011)	To document patients reports of the most troublesome driving tasks and any perceived changes in driving behavior after whiplash injury.	Total n = 33 (f23, m10); WAD n = 33 (f23, m10)	Sustained whiplash injury.	Chronic	NDI, DHQ, structured interview (3 most troublesome driving task), VAS, driving ability (0–10).	73% of the subjects reported a decrease in driving ability, rating an average of 6.7/10. The most frequently nominated troublesome driving tasks were checking blind spots, prolonged driving, and reversing/ reverse parking, and the most frequently cited changes in driving behavior included more use of trunk rotation (75%), altered steering wheel grip (63%), more anxious/ nervous while driving (54%), and more cautious driving (50%).	2, 5a 9, 10: There was ambiguity in patient recruitment, and the adequacy of the sample size remained unclear.

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Table 1 (*continued*)

Citation	Primary aim	Participants	Classification	Symptom duration	Instruments	Summary of results	CASP-criteria unmet
Takasaki et al. (2012)	The primary aim was to develop a questionnaire, the Neck Pain Driving Index (NPDI), to assess the degree of perceived driving difficulty in the chronic whiplash population. The second aim was to establish the reliability and validity of the NPDI.	Total n = 87 (f69, m18); WAD n = 87 (f69, m18)	Chronic WAD patients were recruited from a university whiplash clinic.	Chronic	NPDI.	The three driving tasks with the greatest proportion of scores for moderate or great difficulty were driving for more than 1 h, checking blind spots and reversing.	5: The adequacy of the sample size remained unclear
Valenza et al. (2012)	To determine differences in sleep quality between patients with mechanical neck pain and those with WAD neck pain compared with healthy controls.	Total n = 59 (f47, m12); WAD n = 22 (f18, m4), NSNP n = 19 (f15, m4), C n = 18 (f14, m4)	Neck pain as a results of a motor accident; WAD II according to QST classification.	Acute	NRS, NDI, PSQI.	77% of patients with WAD and 68% with mechanical pain reported poor sleep quality.	5a, 9, 10: The adequacy of the sample size remained unclear.
Verhagen et al. (2011)	To evaluate whether patients with self-reported trauma (whiplash) differ from other patients with non-specific neck pain in respect to perceived pain and functional limitations at baseline.	Total n = 804 (f500, m304); WAD n = 133 (f64, m69); NSNP n = 571 (f436, m235)	Non-spesific neck pain following trauma (whiplash).	Acute/ chronic	Perceived recovery, NRS, NDI, NPQ.	There was a difference between participants with whiplash and non-trauma participants in accompanying low back pain (17–18% more frequent), headache (10% more frequent), and pain scores.	2, 4, 5a, 5b, 10: The choice of material had not been clarified, and different questionnaires and scales were combined.
Wallis et al. (1996)	To explore the utility of the SCL-90-R in assessing WAD -patients.	Total n = 137 (f85, m52); WAD n = 137 (f85, m52)	Chronic neck pain after whiplash injury, specialist consultation before referral.	Chronic	McGill Pain questionnaire, The psychological symptom checklist SCL-90-R.	In addition to neck pain, symptoms included headache (78%), shoulder pain (76%), irritability (70%), disturbance of concentration (69%), sleep disturbance (65%), dizziness (54%), tiredness (40%), visual disturbances (37%) and arm pain (25%).	5a, 5b: The large variation of duration of symptoms and time elapsed since the accident was not considered, and some of the data collection methods (symptom) were unknown.
Wenzel et al. (2009)	To compare the symptom profile of persons with chronic WAD to that of people with either a functional somatic syndrome, an organic pain disorder, or a control group without any of these disorders.	Total n = 52993 (f26777, m26144); WAD n = 785 (f380, m405); C n = 52208 (f26469, m25739)	Self-reported and defined: 1) ”Have you ever had neck injury (whiplash)?” and; 2) Neck pain and stiffness for at least three consecutive months during the last year.	Chronic	Questions: A) 1) During the last year, have you had pain and/or stiffness in the muscles and limbs, which has lasted for at least three consecutive months?’’; 2) if YES:’’Where did you have these complaints?’’; 3) ”Please, indicate the region for which the complaints lasted longest’’; 4)’’Have you been troubled by headaches in the last 12 months?’’; B)’’To what degree have you had these disorders in the last 12 months?’’, HADS.	The chronic WAD group had a significantly higher prevalence of symptoms from all body parts, across organ systems and also mental symptoms, compared to the control group.	2, 4, 5a: The subjects were selected based on self-reporting, and symptoms were self-reported without validated questionnaire.
Quantitative studies							
Case-control studies							

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Table 1 (*continued*)

Citation	Primary aim	Participants	Classification	Symptom duration	Instruments	Summary of results	CASP-criteria unmet
Anarte-Lazo et al. (2022)	Aim was to analyze neck pain and headache intensity, neck disability, kinesiophobia, pain catastrophizing, and anxiety in the short term after a whiplash trauma, comparing differences between those who develop headache or experience worsened headache compared to those who do not.	Total n = 47 (f21, m26); WAD n = 47 (f21, m26)	Patients with a diagnosis of WAD 2 (according to QTF) were recruited from the Traumatology Department of the Clinic. Patients were diagnosed by a physician.	Acute	VAS, NDI, TSK, PCD, STAI	59.5% of the patients had headache.	–
Häggman-Henrikson et al. (2016)	To analyze the prevalence of jaw pain and disability, as well as the relationship between pain and disability in the jaw and neck regions.	Total n = 210 (f124, m86); WAD n = 140 (f82, m58), C n = 70 (f42, m28)	All individuals who visited the emergency department at university hospital with neck pain following a car accident.	Acute	3Q/TMD, NRS, JDC, NDI.	Frequent jaw pain was reported 33.5% in WAD groups and 5.7% of controls. Frequent pain on jaw movements was reported 20.7% in WAD group and 2.9% of controls.	–
Pereira et al., 2008	The aim was to compare driving habits between subjects with chronic whiplash-associated disorder and asymptomatic controls and to determine whether there were any relations among head and eye movement impairments, psychologic features, and self-reported driving ability.	Total n = 60 (f144, m16); WAD 30 (f22, m8)	The WAD group consisted of current drivers with chronic neck pain attributed to an MVC at least 3 months postinjury. The subjects were recruited from patients who attended a university whiplash research unit and through advertising. All subjects were screened for exclusion criteria using an interview.	Chronic	General questionnaire related to history etc., NDI, GHQ-28, IES-R, TSK, DHQ.	The WAD group more often reported that they had driven with the help of a passenger and reported less confidence with driving. A whiplash injury was significantly associated with difficulty over all driving tasks in the modified DHQ except for driving in the rain.	3, 4, 5, 6: There was ambiguity in the recruitment of patients and controls (selection of subjects), and the general self-report questionnaire was not clarified.
Qualitative studies							
Silva Guerrero et al., 2020	The aims were to identify and compare the concerns, fears, and worries associated with their condition that patients with WAD and NTNP have, and to determine and compare whether patients believe their concerns are addressed by their primary care providers.	Total n = 50 (f37, m13); WAD n = 20 (f14, m6); NTNP n = 30 (f23, m7);	WAD group was recruited nonhospitalized individuals who reported neck pain (i.e., WAD) after a motor vehicle crash. NTNP group was recruited individuals who had consulted a health care practitioner.	Chronic	Online survey, NDI, NRS, DASS.	A thematic analysis of the survey responses resulted in seven themes related to common concerns and two themes related to how well the concerns were addressed: 1) further structural damage; 2) psychological distress; 3) concerns about the future; 4) hardships that eventuate; 5), pain/disability is long term (specific to WAD); 6), pain is current or reoccurring and 7) interference with daily life (specific to NTNP)	4, 5: There was ambiguity in the recruitment of patients (selection of subjects from public media advertisements), and there was ambiguity about the selection criteria of the used survey questions.
Juuso et al. (2020)	To describe women's experiences of living with WAD from their perspective, which can inform care designed to meet their individual needs.	Total n = 7 (f7, m0); WAD n = 7 (f7, m0)	Diagnosed WAD by their general practitioner or rheumatologist.	Chronic	Open-ended qualitative interviews.	Six themes of women's experiences with WAD: Living with unpredictable pain; Trying to manage the pain; Living with limitations; Being unable to work as before; Needing support and	3, 4, 6, 9: Information about the validity and reliability of the used interview was not reported, the adequacy of the sample size remained unclear, only women were recruited, the relationship between

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Table 1 (*continued*)

Citation	Primary aim	Participants	Classification	Symptom duration	Instruments	Summary of results	CASP-criteria unmet
						understanding; and learning to live with limitations	researcher and participants was not no considered, and there was no clear statement.
Krohne and Ihlebaek, 2010	To identify what is described as dominant whiplash symptoms, and the behavioral strategies used to cope with WAD.	Total n = 14 (f8, m6); WAD n = 14 (f8, m6)	WAD I-II, to include individuals who stated to have symptoms, but without known pathology.	Chronic	The focus group method.	Participants reported neck and head pain, sensory hypersensitivity, and cognitive dysfunction following their whiplash injury. Based on the intensity of symptoms, participants divided everyday life into good and bad periods. Participants expressed a constant notion of trying to balance their three main coping strategies; rest, exercise, and social withdrawal.	4, 6: There was ambiguity in patient recruitment, and the relationship between researcher and participants was not considered.
Peolsson et al. (2021)	The aim of this study was to explore the experiences of work ability and the work situation of individuals who participated in a neck-specific exercise programme for chronic WAD.	Total n = 17 (f13, m4); WAD n = 17 (f13, m4)	Participants were recruited from an ongoing randomized controlled trial (RCT) evaluating two different ways of distributing neck-specific exercises to individuals with chronic WAD Grade II and III in primary health care.	Chronic	Open-ended interviews.	Five categories related to the participants' narratives on their experiences of work ability and their work situation: Return to work – a process of setbacks and bureaucracy; The need to be understood by health care professionals, and to receive a treatment plan; Individual resources are important for work ability; The consequences of reduced work ability; and Working conditions are important for work ability.	4: There was ambiguity in the recruitment of patients (selection of subjects).

sexual activity, 35% with work, 31% with driving a car and 16% with self-care. A detailed list of symptoms, impairments, and limitations and their domains according to ICF is presented in Table 2. There were some differences between the acute and chronic symptom profiles, as shown in Table 3, for the ten most common symptoms.

3.5.2. *Effect and severity of symptoms*

Due to insufficient quantitative data per outcome measure, the results of the different outcome measures were combined according to the ICF themes. For instance, the NDI, DASH, WDQ, NPQ, PSQI, PET and RPCSQ assessed the severity of sleeping difficulties. The first reviewer (NS) proposed possible subthemes, and eleven were selected after discussion with the second reviewer (SL). The results of each theme were analyzed by comparing the average of the results reported in the studies to the scale used in each instrument. Therefore, different severity scores were scaled to 0–100 to indicate a comparable severity index. The mean values of these new indices are presented in Table 4.

According to the questionnaire scores, the most limited activities related to leisure activity, housework, and education and work. In addition, fatigue and pain were reported as the strongest symptoms, and sleep difficulties as the most disturbing. These results were partially consistent with the qualitative studies, which also highlighted the experience of people with WAD as regards reduced social activity (Juuso et al., 2020; Krohne and Ihlebaek 2010; Peolsson et al., 2021; Silva Guerrero et al., 2020). However, qualitative studies revealed that these limited activities were often associated with pain, sensitivity to sound and light, decreased energy as well as impaired concentration and memory (Juuso et al., 2020; Krohne and Ihlebaek 2010; Peolsson et al., 2021; Silva Guerrero et al., 2020). Furthermore, challenges related to housework, work, and leisure activities, such as family hobbies, seemed to influence the development of stress, guilt, anxiety and sadness (Juuso et al., 2020; Krohne and Ihlebaek 2010; Peolsson et al., 2021; Silva Guerrero et al., 2020).

3.5.3. *Environmental factors*

The effects of environmental factors on the symptom profile were only reported in the qualitative studies. For example, sensitivity to sound and light was experienced as intolerable (Juuso et al., 2020;

Table 2
Prevalence of symptoms, impairments and limitations in people with WAD.

	Symptom (prevalence)	Definition of the ICF class	Studies (n)	Sample size (n)
1.	Neck pain 89%	BODY FUNCTIONS: Sensory functions and pain – *Pain*	20	26533
2.	Shoulder pain 75%	BODY FUNCTIONS: Sensory functions and pain – *Pain*	6	6968
3.	Restricted neck movements 72%	BODY FUNCTIONS: Neuromusculoskeletal and movement-related functions – *Functions of the joints and bones*	6	7049
4.	Headache 70%	BODY FUNCTIONS: Sensory functions and pain - *Pain*	26	26744
5.	Sleeping difficulties 66%	BODY FUNCTIONS: Mental functions – *Global mental functions*	14	4972
6.	Stiff neck 64%	BODY FUNCTIONS: Neuromusculoskeletal and movement-related functions – *Movement functions*	7	4834
7.	Lower back pain 59%	BODY FUNCTIONS: Sensory functions and pain - *Pain*	17	26183
8.	Upper back pain 58%	BODY FUNCTIONS: Sensory functions and pain - *Pain*	8	11173
9.	Fatigue 49%	BODY FUNCTIONS: Functions of the cardiovascular, haematological, immunological and respiratory systems – *Additional functions and sensations of the cardiovascular and respiratory systems*	11	4734
10.	Feeling irritated 47%	BODY FUNCTIONS: Mental functions – *Specific mental functions*	7	719
11.	Dizziness 44%	BODY FUNCTIONS: Sensory functions and pain – *Hearing and vestibular functions*	22	26708
12.	Anxiety 42%	BODY FUNCTIONS: Mental functions – *Specific mental functions*	7	4149
13.	Problems in sexual activities 41%	ACTIVITIES AND PARTICIPATION: Interpersonal interactions and relationships – *Particular interpersonal relationships*	5	514
14.	Numbness of the arm 41%	BODY FUNCTIONS: Sensory functions and pain – *Additional sensory functions*	8	19329
15.	Pain in the arm 41%	BODY FUNCTIONS: Sensory functions and pain - *Pain*	10	11862
16.	Depression 40%	BODY FUNCTIONS: Mental functions – *Specific mental functions*	11	5134
17.	Problems with working 35%	ACTIVITIES AND PARTICIPATION: Major life areas - *Work and employment*	5	545
18.	Feeling restless 33%	BODY FUNCTIONS: Mental functions – *Specific mental functions*	6	763
19.	Driving the car 31%	ACTIVITIES AND PARTICIPATION: Mobility – *Moving around using transportation*	6	455
20.	Nausea 28%	BODY FUNCTIONS: Functions of the digestive, metabolic and endocrine systems – *Functions related to the digestive system*	10	15089
21.	Problems concentrating 27%	BODY FUNCTIONS: Mental functions – *Specific mental functions*	18	19325
22.	Symptoms of ears 19%	BODY FUNCTIONS: Sensory functions and pain – *Hearing and vestibular functions*	8	9470
23.	Tempomandibular joint pain 17%	BODY FUNCTIONS: Sensory functions and pain - *Pain*	7	7893
24.	Functional problems of TMD joint 17%	BODY FUNCTIONS: Neuromusculoskeletal and movement-related functions – *Functions of the joints and bones*	6	13630
25.	Self-care 16%	ACTIVITIES AND PARTICIPATION: Self-care – *Washing oneself*	5	409
26.	Problems with memory 16%	BODY FUNCTIONS: Mental functions – *Specific mental functions*	14	18814
27	Visual problems 13%	BODY FUNCTIONS: Sensory functions and pain – *Seeing and related functions*	13	19955
28.	Auditory problems 12%	BODY FUNCTIONS: Sensory functions and pain – *Hearing and vestibular functions*	10	15306
29.	Problems of swallowing 10%	BODY FUNCTIONS: Functions of the digestive, metabolic and endocrine systems – *Functions related to the digestive system*	5	13300

Table 3
Prevalence of symptoms and impairments in the acute and chronic phases of WAD.

	Acute phase symptom prevalence	Sample size (n)	Chronic phase symptom prevalence	Sample size (n)
1.	Neck pain 90%	23841	Tempomandibular joint pain 92%	104
2.	Restricted neck movements 72%	6984	Restricted neck movements 85%	65
3.	Shoulder pain 75%	6481	Shoulder pain 82%	390
4.	Headache 68%	19605	Fatigue 68%	626
5.	Sleeping difficulties 68%	3991	Neck pain 65%	1393
6.	Stiff neck 67%	3737	Problems with memory 62%	943
7.	Upper back pain 61%	9928	Headache 61%	1272
8.	Lower back pain 59%	18936	Sleeping difficulties 60%	813
9.	Problems with working 59%	51	Feeling irritated 55%	551
10.	Fatigue 46%	3940	Stiff neck 54%	996

Krohne and Ihlebaek 2010). This was perceived to negatively impact one's own life and the family's social life (Juuso et al., 2020). On the other hand, a calm environment, rest, withdrawal from social activities and planning were perceived as important factors for maintaining a balanced life (Krohne and Ihlebaek 2010; Peolsson et al., 2021). Other environmental factors raised were mistrust and lack of understanding. Healthcare professionals, colleagues, employers, people around, and insurance companies were perceived to underestimate the symptoms caused by a whiplash injury (Juuso et al., 2020; Krohne and Ihlebaek 2010; Peolsson et al., 2021; Silva Guerrero et al., 2020). On the other hand, family and friends were considered to offer the best support (Juuso et al., 2020; Peolsson et al., 2021). Underestimation and lack of acceptance were perceived to have a disempowering effect on symptoms, especially mood and isolation (Juuso et al., 2020; Peolsson et al., 2021). In addition, such underestimation was felt to increase the invisibility of the illness (Juuso et al., 2020).

Table 4
The most obstructive symptoms and impairments in people with WAD. The mean values of severity indices. DASH = Disability of the Arm, Shoulder and Hand questionnaire; NDI = Neck Disability Index; NPQ = Nortwick Park neck pain Questionnaire; NRS = Numeric Rating Scale; PET = Problem Elicitation Technique; PSQI = Pittsburg Sleep Quality Index; RHFUQ = Rivermead Head injury Follow Up Questionnaire; RPQ = Rivermead Post-concussion Symptom Questionnaire; VAS = Visual Analogue Scale; WDQ = Whiplash Disability Questionnaire.

ICF domain	Symptom or limitation	Severity (%)	Min-Max (%)	Used instrument	Studies (n)	Sample size (n)
ACTIVITIES AND PARTICIPATION: Community, Social and Civil Life	Leisure activity	46	12–92	DASH, NDI, PET, RFFUQ, WDQ	4	337
BODY FUNCTIONS: Functions of the cardiovascular, haematological, immunological and respiratory systems - *Additional functions and sensations of the cardiovascular and respiratory systems*	Fatigue; Tiredness	44	24–59	PET, RPQ, RHFUQ, WDQ	5	539
ACTIVITIES AND PARTICIPATION: Domestic life - *Household tasks*	Doing housework; Gardening	44	12–73	DASH, NPQ, PET, RHFUQ, WDQ	3	207
ACTIVITIES AND PARTICIPATION: Major life areas	Education; Work and employment	43	18–66	DASH, NDI, NPQ, PET, RHFUQ, WDQ	4	337
BODY FUNCTIONS: Sensory functions and pain - *Pain*	Neck pain; Headache; Upper arm pain; Upper back pain; Lower back pain	42	29–55	DASH, NDI, NPQ, NRS, RPQ, VAS, WDQ	17	8248
BODY FUNCTIONS: Mental functions - *Global mental functions*	Sleeping	42	23–60	DASH, NDI, NPQ, PET, PSQI, RPQ, WPQ	6	473
ACTIVITIES AND PARTICIPATION: Mobility	Carrying and moving objects; Walking and moving; Moving around using transportation	39	14–58	DASH, NDI, NPQ, PET, WDQ	3	225
BODY FUNCTIONS: Mental functions - *Specific mental functions*	Concentration; Memory; Depression; Restlessness; Frustration; Irritability; Anxiety; Anger; Thinking slow; Experience of self; Weight gain	38	20–71	NDI, PET, RPQ, WDQ	5	451
ACTIVITIES AND PARTICIPATION: Self-care	Selfcare	35	27–42	DASH, NDI, PET, WDQ	3	225
ACTIVITIES AND PARTICIPATION: Interpersonal interactions and relationships	Social relationships (friends, family, children, and spouse); Sexual relationship	32	4–76	DASH, NPQ, PET, RHFUQ, WDQ	4	337
ACTIVITIES AND PARTICIPATION: Communication	Communication - receiving and producing; conversation	26	4–39	DASH, NDI, NPQ, PET, RHFUQ	3	207

4. Discussion

This study aimed to construct the symptom profile for people with WAD. Although reports claim that the symptom profile in WAD is wide, no systematic review of the subject has previously been made. Three main themes were identified that described the symptom profile: 1) the prevalence of symptoms, impairments or limitations; 2) the severity of symptoms and the effect of symptoms on functioning, activity and participation; and 3) the effects of environmental factors on the symptom profile. Two-thirds of the symptoms, impairments and limitations identified from the studies related to problems in body functions, and one-third to difficulties executing activities or participating in life situations. In addition, most identified factors affecting the symptom profile were barriers, while relatively few facilitative factors were identified.

When evaluating the impairments, and activity and participation levels in patients with WAD, there is a tendency to concentrate on symptoms in the neck. Although this review revealed that neck pain is the most common symptom and caused several activity limitations and participation restrictions, most people also experienced pain in other regions, such as the head, shoulders, and upper and lower back. However, the effect of whiplash injury on multiple pain areas is unclear. The literature has reported altered pain processing in patients with WAD (Bontinck et al., 2021), as well as nervous system pathology and mechanosensitivity (Fundaun et al., 2022), which may explain widespread symptoms. On the other hand, for example, motor vehicle crashes can cause injuries or symptoms not only to the neck but also to other body parts as well.

In any case, if the symptoms reported by patients with WAD cannot be confirmed to be neck-related, neck-specific instruments, such as the NDI, may not be appropriate or sufficient alone to measure the functional capacity or effectiveness of the intervention. For instance, personal care, work, or sleep difficulties may be due to other symptoms, such as shoulder or low back pain. The same challenge arises in neck-specific interventions. Can this be one reason why the widely used neck-specific interventions only achieve modest results at best? If this is so, then it might be more appropriate to exclude, for example, patients with WAD and shoulder or low back pain or non-cervicogenic headache and dizziness from the neck-specific intervention research or extend rehabilitation programs to those symptom areas experienced by the patients.

The activity and participation limitations and factors affecting the symptom profile were reported very narrowly in the studies included in this review. Studies that assessed the prevalence of symptoms reported only problems in sexual activities, driving a car, self-care, and work. Furthermore, according to the studies reporting the severity of symptoms, restrictions related to leisure activity, household tasks, education, and work were considered relatively significant. The effects of lack of support and attitudes to symptoms were highlighted among the environmental factors. Although these results should be treated with caution, as conclusions were drawn from a minimal amount of data, it does not remove the fact that physical functioning, work, social functioning, psychological functioning, and quality of life are often ignored despite being considered key outcome domains when evaluating patients with WAD (Chen et al., 2019). To discover whether these shortcomings affect, for example, the results of intervention studies, the focus in future should shift evaluations from body functions to disabilities in activities and participation. It can be argued that the literature reviewed for this systematic review does not seem to consider patients with WAD from the standpoint of a biopsychosocial model. Low back pain research shows a parallel discrepancy (Mescouto et al., 2020).

4.1. Study limitations

Several limitations in this study may affect the quality of the data

collected. In most studies, the WAD was self-reported, for example, by asking if the subject had undergone a motor vehicle accident and had neck pain afterwards. Some studies used subjects exposed to rear-end collisions as the whiplash cohort. Although the classification of patients with WAD mainly included the application of the QTF guidelines by history taking and physical examination, the self-report approach might be problematic because not all rear-end collision victims sustain a whiplash injury (Miettinen et al., 2002).

The heterogeneity of the applied instruments and the inadequate reporting of results became a challenge in this review. Several studies only reported symptoms using the total scores of the questionnaires, which was also the most common reason for excluding the quantitative studies during full-text screening progress. This may be the reason why the data on the severity of symptoms or the effect of symptoms on function, disability, limitation, or mental functions such as post-traumatic stress remained small or were completely missing. The total scores of the questionnaires were excluded because they do not describe the symptoms or impairments experienced by people with WAD.

Furthermore, dichotomised or ambiguous questions used in questionnaires can be problematic because they may restrict the answers (Sutton et al., 2003). In this review, over half of the studies used non-validated instruments or methods to measure symptoms and impairments, or general questionnaires, the content of which was not reported. Although several studies also used validated questionnaires and measures, they may nevertheless offer a predigested picture of symptoms and impairments and their relationships. For example, in the NDI, headache and sleeping parameters do not seem to correlate with neck pain disability (Saltychev et al., 2018). However, in this review, qualitative studies revealed that neck pain, headache, and especially pain, in general, were causes of insomnia. On the other hand, the answers in qualitative studies can be more subjective and more tied to time and place than in quantitative studies (Walpole 2019). This leaves the possibility that the studies included in this review weighted symptoms and impairments according to desired priorities. Therefore, whether our review captured the most common or relevant symptoms and impairments in people with WAD is unclear.

There may also be factors in the screening and synthesis processes of the review that may have influenced the results and researchers' conclusions. First, although an ideal search would include all papers regardless of language (Walpole 2019), only studies published in English were included in our review. Although most of the studies included in our review were conducted in English-speaking populations or research environments such as the Nordic countries, it does not eliminate the possibility that studies in languages other than English could not have influenced the research results. Second, the number of studies excluded in both screening phases differed significantly between NS and SL. In particular, psychological symptoms triggered a debate about whether they were the patients' own experiences or conclusions made by someone else. The inconsistency of the first phase screening process may also be due to the lack of information in the titles and abstracts of the studies (Doust et al., 2005). Finally, the possibility of misinterpretations by the researchers in the aggregation of data into the ICF domains should also be considered.

5. Conclusion

The literature included in this review describes a wide variety of symptoms in people with WAD. However, it does not adequately describe how neck and other symptoms affect a patient's function, activity, or levels of participation. These suggest that considering the symptom profile and clinical findings after whiplash injury to be primarily neck-related may be misdirected. Therefore, assessment and rehabilitation focusing only on neck-related symptoms, for example, after motor vehicle crashes, may miss important and potentially relevant aspects experienced by patients. On the other hand, a whiplash injury can also cause wide-ranging symptoms, but their origin should be verified, especially in neck-specific interventions. It can be argued that decisions are currently made with incomplete information that can have enormous social and economic implications for the patient and society.

In the future, research should not only use leading questions about pre-defined pain areas and disabilities but rather offer patients with WAD the opportunity to report their symptoms in different ways. This can facilitate understanding the complexity of a patient's situation and the interactions between different symptoms, impairments, activities, participation, and environment. In addition, it can help to determine the condition-specific symptom profile, which provides the basis for accurate assessment, correct diagnosis, and targeted treatment.

Reprints

No reprints are available. A poster abstract of the manuscript was accepted to the World Congress of Pain 2022.

Registration number

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CRediT authorship contribution statement

Niklas Särkilahti: Writing – review & editing, Writing – original draft, Visualization, Project administration, Methodology, Investigation, Data curation. **Saara Leino:** Writing – review & editing, Writing – original draft, Methodology, Investigation, Conceptualization. **Jani Takatalo:** Writing – review & editing, Supervision, Investigation. **Eliisa Löyttyniemi:** Writing – review & editing, Formal analysis. **Olli Tenovuo:** Writing – review & editing, Supervision.

Declaration of competing interest

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Appendix A. Supplementary data

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