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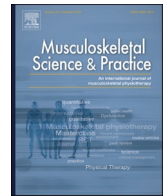
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## Headache features in people with whiplash associated disorders: A scoping review

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### ABSTRACT

**Background:** Whiplash-associated headache (WAH) is one of the most common symptoms after a whiplash injury, leading to high disability. Nevertheless, the clinical characteristics of WAH have not been well described.

**Objective:** To synthesise the existing literature on the clinical characteristics of WAH.

**Design:** Scoping review.

**Methods:** The protocol for this scoping review was registered in Open Science Framework and the PRISMA extension for Scoping Reviews tool was used to ensure methodological and reporting quality. A systematic search was conducted in PubMed, EMBASE, CINAHL, Web of Science and Scopus. The search was performed by one author and the screening of articles was conducted by two authors independently.

**Results:** A total of 11363 articles were initially identified and finally 26 studies were included in the review. Headache intensity was the most commonly reported feature. Headache duration, frequency and location were also reported in at least four studies. Few studies reported physical impairments that may be related to the presence of WAH. A differentiation with concussion characteristics was only performed in eight studies.

**Conclusion:** WAH appears to be of mild to moderate intensity, typically with episodes of short duration which is commonly experienced in the occipital region amongst other regions, and with a tendency to reduce in intensity over time.

## 1. Introduction

Whiplash is a term that refers to the mechanism involving a sudden acceleration-deceleration movement of the craniocervical complex, resulting in bony or soft-tissue injuries (Monaro et al., 2021a), with an incidence of more than 300 persons per 100,000 people (Holm et al., 2009). The variety of clinical manifestations after a whiplash injury is known as whiplash-associated disorders (WAD), and includes diffused neck pain, neck stiffness, fatigue, vision disturbances and/or headache (Monaro et al., 2021b). It has been reported that ~79% of people who suffered from a whiplash injury still report some residual pain 12 months later (Olsson et al., 2002).

In a recently published systematic review, headache was found to be present in 60% of people within 7 days after a whiplash injury, and in 38% after one year. However, the authors stated that, due to high

heterogeneity in the definition of a whiplash injury and the way of reporting post-whiplash sequelae among studies, future research should improve and standardise these terms (Al-Khazali et al., 2020). The International Headache Classification Disorders (ICHD-III) (Headache Classification Committee of the, 2018) only states that, to consider headache as a consequence of the whiplash injury, it must develop (or increase, if another headache condition was already present) within 7 days after the whiplash injury, without stating any further headache features. Nonetheless, some studies have reported some headache features which are common after a whiplash injury. Firstly, whilst insidious onset cervicogenic headache (CGH) is typically felt as a unilateral headache, people with headache after a whiplash injury more frequently report headache bilaterally (Drottning, 2003). In addition, in people who experience headache after a whiplash injury, mechanically precipitated headache can be provoked by pressure applied over the

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greater and minor occipital nerves (Drottning, 2003). Moreover, a cohort study with 557 patients found that headache commonly radiated from the neck to the forehead and often into the eye, with patients using a line to illustrate their pain rather reporting pain over their entire head. Their headache was also elicited more commonly with static neck positions such as flexion or extension, was described as non-pulsating and, more often, intermittent. In addition, when using a Visual Analogue Scale to measure headache intensity, they reported a mean headache intensity of 5.5 on a scale between 1 and 9 at 6 weeks post-injury (Drottning et al., 2002).

Some studies have found that factors such as higher neck pain intensity, higher disability, or psychological factors, among others, can predict poorer prognosis following a whiplash trauma (Walton et al., 2013; Côté et al., 2001; Radanov et al., 1993). However, it has been stated that the lack of clear descriptive characteristics can make it difficult to assess prognosis in the case of headache attributed to a whiplash injury (Schrader et al., 2006). In addition, clinicians must be cautious when interpreting headache symptoms after a whiplash injury, also known as whiplash-associated headache, since both the symptomatology and mechanism of injury are very similar to that of concussion (Gil and Decq, 2021). Unlike other headache types (Headache Classification Committee of the, 2018), whiplash-associated headache has not been well characterised. A deeper understanding of whiplash-associated headache and its clinical presentation may ultimately improve patient management.

The aim of this scoping review was to synthesise the literature describing the clinical features that characterize headache that people experience after a whiplash injury. The evidence synthesis from this scoping review may help to identify the main characteristics of headache following a whiplash trauma which may assist clinicians with differential diagnosis.

## 2. Methods

This review focuses on the evaluation of clinical features of headache in patients with WAD. The protocol for this scoping review was registered in Open Science Framework (<https://osf.io>). This review was based on the framework outlined by Arksey and O'Malley (2005) and later developed by Levac et al. (2010). The PRISMA extension for Scoping Reviews (PRISMA-ScR) tool (Tricco et al., 2018) was used to improve the quality of this review. According to Arksey and O'Malley (2005) and Levac et al. (2010), five stages of a scoping review must be accomplished and therefore our review included five iterative steps: a) identifying the research question, b) searching for relevant studies, c) selection of studies, d) charting the data, and e) collating, summarizing, and reporting the results.

### 2.1. Identifying the research question

This scoping review sought to answer the following question: "What are the clinical characteristics of headache attributed to a whiplash injury?". Three sub-questions were addressed:

- What is the common frequency, intensity, episode duration, and location of whiplash-associated headache?
- What diagnosis was made, and how was the assessment performed, and by which professional?
- Do studies differentiate between headache caused by whiplash versus concussion?

The participant, concept, and context (PCC) (Tricco et al., 2018) framework of this scoping review can be found in Appendix A.

### 2.2. Identifying relevant studies

#### 2.2.1. Eligibility criteria

We included studies involving people who experience headache after a whiplash injury and specifically included people diagnosed as headache attributed to a whiplash injury, following the criteria from IHCD-III (Headache Classification Committee of the, 2018). Study designs included cross-sectional, cohort retrospective and prospective studies and randomized controlled trials when headache characterization was described prior to the intervention. Inclusion was limited to studies published in English in peer-reviewed journals until 17/02/2022. Articles reporting the headache characteristics outlined below were the aim of this review.

We excluded articles which included people with WAD amongst other patients unless data was reported separately for people with WAD (e.g., patients with WAD included in a sample of people with chronic neck pain). Additionally, we excluded articles that presented the same data (i.e., secondary analyses) for a sample already included in the review in another publication.

#### 2.2.2. Information sources

Articles were identified by searching the following electronic databases: PubMed, CINAHL, Web of Science, Scopus and EMBASE. Manual search of specific journals will be conducted targeting journals of interest (Cephalalgia, Headache, The Journal of Headache and Pain, Current Pain and Headache Reports). In addition, we scanned the "related articles" link of these databases. Moreover, studies found in the field of whiplash and headache which did not include data from the participant assessment were checked according to a snowball method to identify additional relevant articles.

#### 2.2.3. Search strategy

We used a sensitive search strategy using a combination of Medical Subject Headings (MeSH) and words such as "whiplash injury" OR "post-traumatic headache" AND "headache" AND "clinical trial" OR "cohort study" OR "cross-sectional study". An example of the search strategy that was used in PubMed can be found in Appendix B. It was developed by consensus of all authors, with the help of a librarian and was conducted by a single investigator (EA). Results from the search strategy were stored in EndNote.

### 2.3. Selecting the studies

After removing duplicates, two reviewers (EA and DA) independently screened titles/abstracts against the prespecified eligibility criteria. For those that met the inclusion criteria, the full text was obtained. If there was any uncertainty, the full text was retrieved for further clarification. Articles were included when eligibility was confirmed by both reviewers. Any disagreement between both reviewers was discussed first, and if necessary, a third reviewer (DF) was consulted. The full text was assessed by both reviewers (EA and DA). Disagreement was resolved in the same way.

### 2.4. Charting the data

#### 2.4.1. Data extraction

A data extraction spreadsheet was developed and the data was extracted by EA and checked by DA. Disagreement was resolved by a third reviewer (DF) if needed.

#### 2.4.2. Data charting

Data extracted included a) study and participant characteristics and b) headache features. More specifically: a) research design, sample size, time from the accident, diagnosis, and whether any physical findings were related to the presence of post-whiplash headache; b) headache features such as time since the headache started relative to the whiplash

injury, headache intensity, frequency, localization and episode duration, and whether the headache suffered is characterized as the presentation of a specific headache condition (e.g., migraine or tension-type headache), whether a differentiation with concussion was taken into account, method of headache assessment (interview, diary, clinical examination, etc), and professional (neurologist, primary care physician, etc) who performed the diagnosis. Data on the process of diagnosis and inclusion criteria used in the studies was analysed to describe the patient populations.

## 2.5. Collating, summarizing and reporting the results

Since a scoping review aims to map the concepts underlying a research question, our findings provided an overview of the search question taking into account the assessment of the quality of individual studies. This study performed a narrative synthesis in line with the screening and extraction datasheet. All authors discussed and agreed on the final reporting of results, subgrouping on different sub-questions.

## 3. Results

The systematic search of the five databases initially identified 11303

articles and 60 additional articles were identified through hand searching. After duplicates were removed, 3912 studies remained. The titles and abstract of these studies were screened and the full text of 94 studies were assessed. Finally, 26 studies were included in the review. The search results are displayed in the PRISMA Flow Diagram (Fig. 1). Summary of the extracted data can be found in Tables 1 and 2.

### 3.1. Study design and participant characteristics

Among the included studies, nine were cross-sectional (Anarte-Lazo et al., 2022; Antonaci et al., 2002; Astrup et al., 2021; Dumas et al., 2001; Hagström and Carlsson, 1996; Keidel et al., 2001; Obermann et al., 2009; Sturzenegger et al., 1995; Watson and Drummond, 2016), nine prospective studies (Drottning et al., 2002, 2007; Andersen et al., 2022; Crutebo et al., 2010; Sameh et al., 2013; Obelieniene et al., 1999; Obermann et al., 2010; Pearce, 2001; Radanov and Sturzenegger, 1996), four retrospective studies (Bunketorp et al., 2002; Chua et al., 2012; Obelieniene et al., 1998; Schrader et al., 1996), two controlled studies (Blokhorst et al., 2005; Borchgrevink et al., 1998) and two experimental studies (Lord et al., 1994; Magnússon et al., 1996). The number of people recruited ranged from 22 to 1005. Some studies specified the number of participants with whiplash-associated headache, but

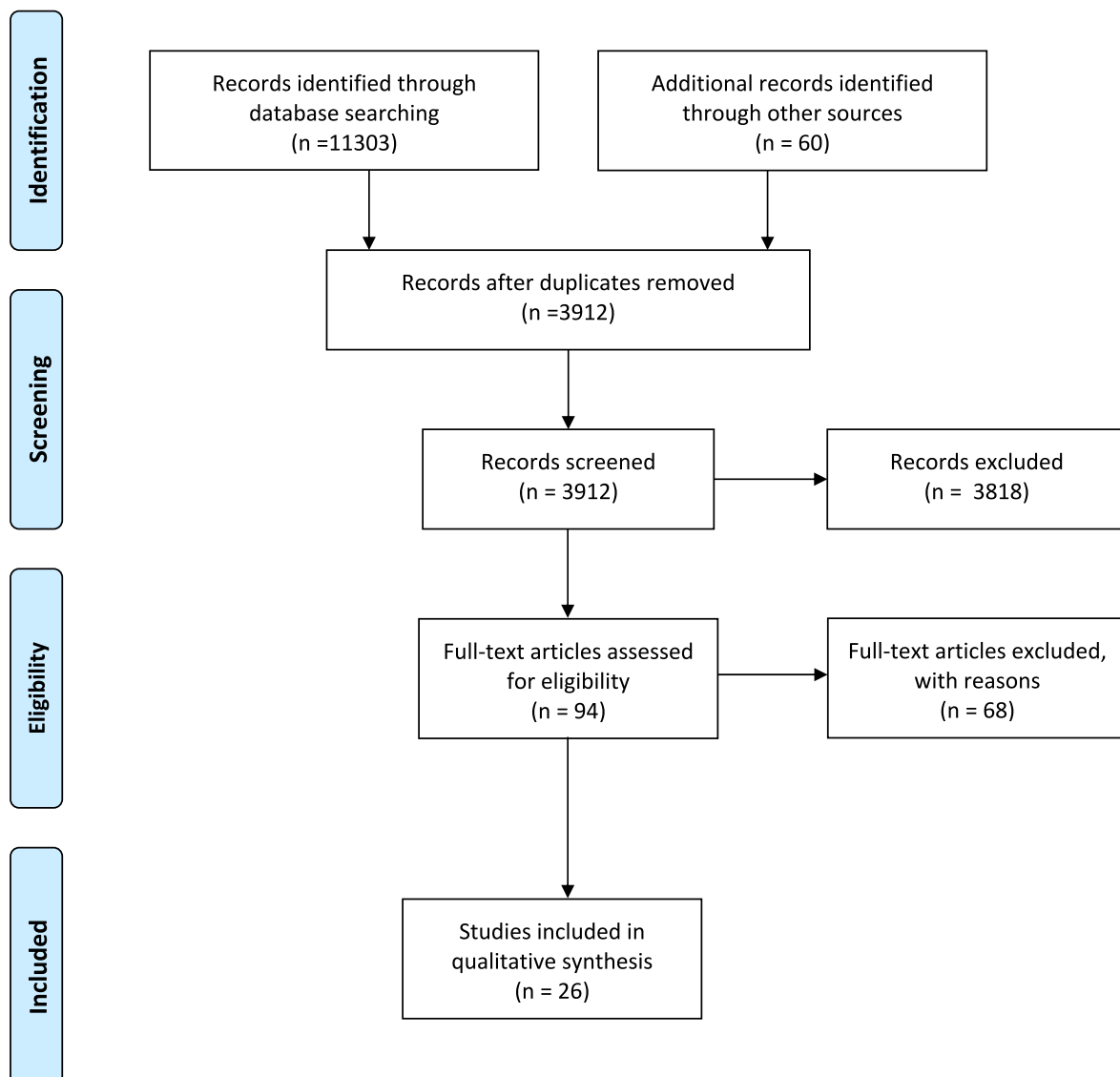


Fig. 1. PRISMA flow diagram.

**Table 1**  
Study and participant characteristics. In the sample size, the number of people with headache are included between parentheses.

Study	Design	Sample size	Age (years)	Sex; M/F	Time from the accident	Diagnosis	Physical findings
Anarte-Lazo et al., 2022	Cross-sectional	47 (28)	37.6	12/16	11.4 days	WAD II	–
Andersen et al., 2022	Prospective	737 (Headache not stated)	34.8	266/471	Maximum 10 days after the accident	Whiplash Injury	–
Antonaci et al., 2002	Cross-sectional	70 (70)	33	18/52	–	WAD II-III	–
Astrup et al., 2021	Cross-sectional	22 (21)	38	18/4	–	WAD II	–
Blokhorst et al., 2005	Controlled study	28 (28)	–	–	–	WAD I-II	–
Borchgrevink et al., 1998	RCT	178 (28)	37.2	32/50	–	WAD I-III	–
Bunketorp et al., 2002	Retrospective	59 (41)	54	23/36	17 years	Whiplash Injury	–
Chua et al., 2012	Retrospective	45 (45)	41	27/18	7 years	Whiplash Injury with CGH	–
Crutebo et al., 2010	Prospective	1005 (661)	–	247/414	18.2 days	WAD I-III	–
Drottning et al., 2002	Prospective	587 (222)	38	2/3 at all intervals	–	WAD I-III	Based on rough clinical estimation Reduced ROM Flexion: 22% Extension: 35% Side flexion: 47% Rotation: 29%
Drottning et al., 2007	Prospective	14 (7)	44	1/6	6 years	WAD I-III	ROM: Reduced with respect to 6 and 1 year (Drottning2002)
Dumas et al., 2001	Cross-sectional	20 (20)	45	5/15	5.8 years (mean)	Whiplash injury	Compared to controls, reduced flexion/extension, rotations, flexors and extensors strength, flexors endurance, and increased VAS in trapezius and mandibular angle in the skin roll test
Sameh et al., 2013	Prospective	54 (37)	45.8	12/42	–	Whiplash injury	–
Hagström and Carlsson, 1996	Cross-sectional	30 (11)	35	8/22	–	Whiplash Injury	–
Keidel et al., 2001	Cross-sectional	82 (82)	28.3	35/47	14 days	WAD I-III	–
Lord et al., 1994	Experimental	100 (71)	41	1/2	At least 3 months	Whiplash Injury	–
Magnússon et al., 1996	Experimental	274 (13)	38.1	6/9	At least 6 months	Whiplash Injury	–
Obelieniene et al., 1998	Retrospective	202 (101)	–	–	–	Whiplash injury	–
Obelieniene et al., 1999	Prospective	210 (76)	38	181/29	11 days	Whiplash injury	–
Obermann et al., 2009	Cross-sectional	32 (32)	35.2	12/20	14 days-3 months	Whiplash injury	–
Obermann et al., 2010	Prospective	133 (133)	33.5	43/90	1–198	WAD I-II	–
Pearce, 2001	Prospective	80 (48)	24	29/51	–	WAD I-II	–
Radanov and Sturzenegger, 1996	Prospective	117 (67)	30.7	50/67	–	WAD I-III	–
Schrader et al., 1996	Retrospective	202 (107)	43	157/45	1–3 years	WAD I-III	–
Sturzenegger et al., 1995	Cross-sectional	137 (78)	30.8	56/81	7.2 days	WAD I-III	–
Watson and Drummond, 2016	Cross-sectional	22	36.3	2/20	–	Whiplash injury	–

WAD: Whiplash-Associated Disorders; numbers I-III refers to the WAD Grade according to the Quebec Task Force. CGH: cervicogenic headache.

headache features were reported based on the entire population studied (Crutebo et al., 2010; Obelieniene et al., 1999; Bunketorp et al., 2002; Borchgrevink et al., 1998), and others only included people with whiplash-associated headache or included other headache groups but people with whiplash-associated headache were presented independently (Dumas et al., 2001; Watson and Drummond, 2016; Obermann et al., 2010; Chua et al., 2012; Blokhorst et al., 2005). Comparison between groups with people with whiplash with and without headache was only performed once (Anarte-Lazo et al., 2022). The average

participant age ranged from 28.3 to 54 years old. All studies reported a greater proportion of women among the participants included except four (Astrup et al., 2021; Obelieniene et al., 1999; Chua et al., 2012; Schrader et al., 1996).

### 3.2. Diagnosis and physical findings

Eleven studies included people with a whiplash injury without specifying the grade of the condition or other diagnoses (Dumas et al.,

**Table 2**  
Headache features.

Study	Assessment	Professional	Headache Intensity	Headache Frequency	Headache Duration	Headache Area	Characterization with another headache	Differentiation with concussion
Anarte-Lazo et al., 2022	Questionnaire	Physician	47.4 (VAS)	–	–	–	–	Yes
Andersen et al., 2022	Interview	–	NRS Baseline: 3.4 3 months: 3.6 6 months: 3.0 12 months: 3.2	–	–	–	–	Only amnesia or unconsciousness in relation to the trauma
Antonaci et al., 2002	Interview	–	–	–	–	–	CGH: 34.3%; M: 11.4%; HN: 14.3%; CGH + M: 11.4%; CGH + HN: 8.6%; NC: 20%	No
Astrup et al., 2021	Interview	–	–	Daily: 28.5% Some d/w: 71.5%	–	–	–	No
Blokhorst et al., 2005 <sup>a</sup>	Questionnaire	–	2.4 (NRS)	–	–	–	–	No
Borchgrevink et al., 1998 <sup>a</sup>	Questionnaire	–	2.7 (NRS)	–	–	–	–	Yes
Bunketorp et al., 2002 <sup>a</sup>	Questionnaire	–	Mild: 14% Moderate: 41% Severe: 15%	Several t/m: 29% Several t/w: 31% Daily: 10%	–	Occipital: 64% Forehead/orbital regions: 54% Frontal and occipital: 33% Temporal region: 28%	–	No
Chua et al., 2012	Questionnaire	–	8.51 (NRS)	–	–	–	CGH	No
Crutebo et al., 2010 <sup>a</sup>	Questionnaire	–	Baseline: 1.9 (NRS)	–	–	–	–	No
Drottning et al., 2002	Questionnaire	–	VAS (1–9) 6 weeks: 5.5 6 months: 5.5 1 year: 5.2	Non-CGH: >8 d/m: 1 year: 38% >15 d/m 6 weeks: 20% ·CGH >8 d/m: 6 weeks: 50% 1 year: 50% >15 d/m 6 weeks: (50%) 6 months: 25% 1 year: 20%	· Non-CGH: <4h: 58% 4–72h: 26% >72h: 5% Non-specified: 11% · CGH <4h: 6 weeks: 30% 1 year: 45% 4–72h: 6 weeks: 25% 1 year: 25% >72h: 6 weeks: 10% 1 year: 10%	–	6 weeks: 23.76% CGH 6 months: 12.87% CGH 1 year: 9.9% CGH Non-pulsating and intermittent All unilateral	Yes
Drottning et al., 2007	Questionnaire	–	–	>8 d/m: 43% >15 d/m: 14%	–	Occipital: 6/7 Frontotemporal: 4/7 Temporal: 1/7	7/14: CGH	No
Dumas et al., 2001	Interview	–	–	28.0 d/m	–	–	Defined as CGH after a motor vehicle accident	Yes
Sameh et al., 2013	Questionnaire	–	–	–	–	Frontal: 24% Occipital: 12.9% Frontal and occipital: 31.48% Frontal: 28–33% Occipital: 17–22%	–	No
Hagström and Carlsson, 1996	Interview	–	–	–	–	–	–	No
Keidel et al., 2001	Interview	–	–	–	–	Frontal: 4% Temporal: 4% Occipital: 32% Holocephal with occipital preponderance: 60% (93% bilateral)	Not specifically; 9% pulsating, 91% dull pressing	Yes

(continued on next page)

Table 2 (continued)

Study	Assessment	Professional	Headache Intensity	Headache Frequency	Headache Duration	Headache Area	Characterization with another headache	Differentiation with concussion
Lord et al., 1994	Interview	General practitioners	–	–	–	–	21/71 classified as third occipital nerve headache	No
Magnússon et al., 1996	Interview	–	–	12/13 daily; 11/13 more than 50% of time	Continuous: 85% Headache attacks: 46% 4–72h: 23%	Frontal and occipital: 100% Bilateral: 92% Facial pain below eye: 15%	Occipital neuralgia; 11/13 pulsating headache	No
Obelieniene et al., 1998	Questionnaire	–	–	<1 d/m: 12.9% 1–15 d/m: 27.3% >15 d/m: 7.9% Uncertain: 4%	–	–	Migraine: 12.9% ETTH: 44.5% CTTH: 7.9% CGH: 15.8% Unclassifiable: 28.71%	No
Obelieniene et al., 1999 <sup>a</sup>	Questionnaire	–	–	>7 d/m: 5.1% after 2 months; 4.0% after 1 year	–	–	–	No
Obermann et al., 2009	Dairy	–	4.7 (VRS)	–	–	Bilateral headache: 83%	Predominant dull, pressing/tightening pain quality: 90%	No
Obermann et al., 2010	Interview	Neurologist	5.9 (VRS)	All had daily or near-daily headache	6.9h	Bilateral headache: 77.2%	Predominant dull, pressing/tightening pain quality: 87.3%	No
Pearce, 2001	Questionnaire	–	–	Intermittent in 68.7% at 10 days	–	Occipital: 58.3% Generalised: 27.09% Hemicrania: 6.2%	Some features of TTH: 52.09% Migraine without area: 6.2% Typical TTH: 12.4% Non-specific, mixed: 25% Momentary stabbing or shooting pain: 4.1%	No
Radanov and Sturzenegger, 1996	Questionnaire	–	3.0 (NRS)	–	–	–	–	Yes
Schrader et al., 1996	Questionnaire	–	–	<1 d/m: 52.3% 1–7 d/m: 29.91% >7 d/m: 17.75%	–	–	–	No
Sturzenegger et al., 1995	Interview	–	3.1 (NRS)	–	<1 h: 45.9% 1–24 h: 28.6% >24 h: 25.5%	–	–	Yes
Watson and Drummond, 2016	Questionnaire	–	–	–	–	Bilateral: 63.6% Unilateral: 36.2% Temporal: 36.4% Frontal: 63.6% Retroorbital: 31.8% Occipital: 36.4%	TTH: 27.3% Migraine: 36.4% Mixed: 36.4% Ache/pressure: 63.6% Pulsating: 45.45% Sharp/stabbing: 9.1%	No

- d/m: day per month; t/w: times per week; t/m: times per month; WAD: Whiplash-Associated Disorders; CGH: cervicogenic headache; ETTH: episodic tension-type headache; CTTH: chronic tension-type headache; M: Migraine; HN: Hemi Neuralgia.

<sup>a</sup> Headache characteristics were reported including people with and without headache.

2001; Hagström and Carlsson, 1996; Obermann et al., 2009; Watson and Drummond, 2016; Andersen et al., 2022; Sameh et al., 2013; Obelieniene et al., 1998, 1999; Bunketorp et al., 2002; Lord et al., 1994; Magnússon et al., 1996). The rest of studies specified the WAD grade: two with WAD grade II (Drottning et al., 2002, 2007; Anarte-Lazo et al., 2022; Astrup et al., 2021; Keidel et al., 2001; Crutebo et al., 2010; Radanov and Sturzenegger, 1996; Borchgrevink et al., 1998), eight with WAD grade I-III (Drottning et al., 2002, 2007; Keidel et al., 2001;

Sturzenegger et al., 1995; Crutebo et al., 2010; Radanov and Sturzenegger, 1996; Schrader et al., 1996; Borchgrevink et al., 1998), four WAD I-II (Obermann et al., 2010; Pearce, 2001), and one study included people who had experienced a whiplash injury and presented with CGH (Chua et al., 2012).

No studies reported differences in physical findings between participants with WAD with and without headache. Physical findings related to the presence of headache after the whiplash injury were reported in

only three studies. In one, ROM was reduced in all movement directions (Drottning et al., 2002), and a follow-up at 6 years (Drottning et al., 2007) demonstrated even greater reduction in ROM. Finally, another study found reduced flexion/extension, rotation ROM, reduced neck flexor and extensor strength, reduced neck flexor endurance, and increased pain intensity on over the trapezius and mandibular angle during the skin roll test when compared to healthy controls (Dumas et al., 2001).

### 3.3. Time from the accident

Outcome measures were assessed at different time points after the whiplash injury across the different studies. The earliest assessment was performed in a prospective study, with participants recruited a maximum of ten days after the accident (Andersen et al., 2022), and in a cross-sectional study with a mean of 7.2 days after the accident (Sturzenegger et al., 1995), with headache intensity of 3.9 and 3.1, respectively. Some studies recorded data between five and seventeen years after the accident (Dumas et al., 2001; Drottning et al., 2007; Bunketorp et al., 2002; Chua et al., 2012). Of these, the highest headache intensity reported was 8.51 (Chua et al., 2012).

### 3.4. Headache intensity

Thirteen studies reported headache intensity. Two studies used a VAS to assess headache intensity in the acute/subacute stage with scales ranging from 0 to 100 (Anarte-Lazo et al., 2022) and 0–9 (Drottning et al., 2002), and results of 47.4 and 5.5, respectively. Two studies stated that they assessed headache intensity via a visual rating scale (VRS) from 0 to 10, with scores of 4.7–5.9 reported (Obermann et al., 2009, 2010). The majority of studies evaluated pain intensity based on a numerical rating scale (Sturzenegger et al., 1995; Andersen et al., 2022; Crutebo et al., 2010; Radanov and Sturzenegger, 1996; Chua et al., 2012; Blokhovst et al., 2005; Borchgrevink et al., 1998) with scores ranging from 1.9 (Crutebo et al., 2010) to 8.51 (Chua et al., 2012). Additionally, one study reported headache according to mild, moderate or severe levels (Bunketorp et al., 2002), with only 15% of patients suffering a severe headache intensity.

### 3.5. Headache frequency

The frequency of the headache episodes was reported in 12 studies. Different ways of measuring headache frequency were reported, such as daily, several times per week, several times per month (Astrup et al., 2021; Bunketorp et al., 2002) or more than 50% of the time (Magnússon et al., 1996). In the studies assessing headache in the acute/subacute stage (<30 days), daily headache was reported at least in 28.5% of participants (Astrup et al., 2021), but some studies reported that all patients or almost all presented with daily headache (Obermann et al., 2010; Magnússon et al., 1996). In the studies assessing whiplash-associated headache in the long term, the frequency ranged from daily headache in 10% of people 17 years after the accident (Bunketorp et al., 2002) to 28 days per month when assessed 5.8 years after the whiplash injury (Dumas et al., 2001).

### 3.6. Headache duration

Only four studies recorded the duration of headache episodes. In patients in the acute/subacute phase, the mean was found to be 6.9 h (Obermann et al., 2010). Nonetheless, another study reported that near 50% suffered from headache episodes of less than 1 h (Sturzenegger et al., 1995). At six months, 23% of participants reported headache episodes from 4 to 72 h (Magnússon et al., 1996). Headache episodes of more than 72 h was present in 10% of participants both at 6 weeks and 1 year after the accident (Drottning et al., 2002).

### 3.7. Headache location

The location of headache was investigated in 10 studies. The prevalence of headache in the frontal or frontal and occipital region ranged widely from 4% (Keidel et al., 2001) to 100% (Magnússon et al., 1996). Headache in the temporal region was reported in five studies, ranging from 4% (Keidel et al., 2001) to 36.4% (Chua et al., 2012). Orbital/retroorbital headache was reported in two studies, with a prevalence of 54% (Bunketorp et al., 2002) and 31.8% (Chua et al., 2012). The area of headache reported in most studies was the occipital region with eight studies demonstrating that the prevalence of headache in this region ranges from 17% (Hagström and Carlsson, 1996) to 100% (Magnússon et al., 1996). Facial pain below the eye was found in 15% of patients in one study (Magnússon et al., 1996). Additionally, bilateral headache was reported in three studies, being present in up to 92% of patients (Magnússon et al., 1996), with a higher prevalence than unilateral headache, which was found to be present in 36% of participants in another study (Chua et al., 2012). Hemicrania was reported in another study with a prevalence of 6.2% (Pearce, 2001) whereas another study reported that the pain was holocephalic with occipital preponderance in 60% of participants (Keidel et al., 2001).

### 3.8. Characteristics with another headache type

Thirteen studies reported that the whiplash-associated headache presented characteristics of another headache condition. Up to 90% of participants suffered a headache which was described as predominantly dull, with a pressing quality (Keidel et al., 2001; Obermann et al., 2009).

Concerning the characteristics with another headache type, occipital neuralgia and third occipital nerve headache was reported in two studies (Lord et al., 1994; Magnússon et al., 1996). Cervicogenic whiplash-associated headache was described in five studies (Drottning et al., 2002; Antonaci et al., 2002; Dumas et al., 2001; Chua et al., 2012; Obelieniene et al., 1998), while migraine was described to be present in the population examined in four studies (Drottning et al., 2002; Antonaci et al., 2002; Pearce, 2001; Obelieniene et al., 1998). Finally, characteristics of TTH was identified in the population examined in three studies (Pearce, 2001; Chua et al., 2012; Obelieniene et al., 1998).

### 3.9. Differentiation with concussion

In seven studies (Drottning et al., 2002; Anarte-Lazo et al., 2022; Dumas et al., 2001; Keidel et al., 2001; Sturzenegger et al., 1995; Radanov and Sturzenegger, 1996; Borchgrevink et al., 1998), concussion was included as an exclusion criteria, and amnesia and unconsciousness related to the accident were considered as exclusion criteria in one study (Andersen et al., 2022). The remaining studies made no reference to concussion.

### 3.10. Form of assessment and assessor

Only three studies reported the professional who performed the assessment to determine the presence of headache: physician (Anarte-Lazo et al., 2022), general practitioner (Lord et al., 1994) and neurologist (Obermann et al., 2010). The assessment of headache characteristics was performed through an interview in 10 studies, via questionnaires in 15 studies and with the use of a diary in one study (Obermann et al., 2009).

## 4. Discussion

This scoping review aimed to summarise the available evidence concerning the characteristics of headache following a whiplash injury. To the best of our knowledge, this is the first scoping review providing an overview of clinical characteristics of headache in people with WAD. This review offers clinicians a summary of the scientific literature which



may facilitate clinical reasoning for those working with patients reporting whiplash associated disorders with a symptom of headache. Nonetheless, given the heterogeneity of findings, this review reveals that further studies assessing headache after a whiplash injury are needed in order to better understand the common clinical characteristics of whiplash-associated headache.

#### 4.1. Study and participant characteristics

Concerning participant characteristics, an interesting observation was the higher prevalence of whiplash-associated headache in women. Although one study reported no significant difference between those who develop headache and those who do not soon after a whiplash injury (Anarte-Lazo et al., 2022), we found that in all but four studies (Astrup et al., 2021; Obelieniene et al., 1999; Chua et al., 2012; Schrader et al., 1996), the prevalence of headache was higher for women, which may reveal a higher predisposition of women to develop headache after a whiplash injury.

Since there are no studies reporting differences in physical impairments between people with WAD with and without headache, it is relevant for future studies to examine this. In addition, future research could examine whether certain physical impairments could be characteristic of any particular headache condition. Given the heterogeneity and overlap in symptoms between different headache types, the consideration of physical impairments may facilitate diagnosis and ultimately, the treatment of headache.

#### 4.2. Headache characteristics

Following neck pain, headache is one of the most common reported symptoms for people with WAD. However, concussion symptoms and whiplash-associated headache are common after a cranio-cervical trauma and they overlap on many features, with similar pathophysiological mechanisms (Gil and Decq, 2021). In this review, we identified less than 50% of studies which considered concussion or some of its characteristics as an exclusion criterion.

For all the headache features assessed in this review, there was a large degree of heterogeneity in reporting data. Nonetheless, some characteristics of whiplash-associated headache can be summarised. According to the findings from this scoping review, headache intensity did not appear to be very high, with only a 15% of patients reporting severe headache (Bunketorp et al., 2002) and only two studies reporting scores greater than the midpoint of the visual analogue scale or numerical rating scale for headache intensity (Drottning et al., 2002; Chua et al., 2012). Thus, it could be stated that whiplash-associated headache intensity appears to be mild to moderate with a small proportion of patients suffering from severe headache. It is already known that neck pain is usually the most disturbing symptom after a whiplash injury for the majority of patients, with only few patients reporting that headache as their worst symptom (Al-Khazali et al., 2020). A further observation is that headache intensity appears to reduce over time (Drottning et al., 2002; Andersen et al., 2022), which is in line with a reduction of headache prevalence in the long term (Al-Khazali et al., 2020). Some patients reported suffering from whiplash-associated headache daily during the acute/subacute phase, however most patients reported experiencing headache approximately fifteen days per month. Headache frequency also seems to reduce in the long term, with only 10% of patients suffering daily headache 17 years after the accident (Bunketorp et al., 2002).

The duration of headache episodes was only reported in a few studies. From these reports, headache episodes appear to be short lasting, with most patients experiencing headache episodes of one to 7 h. However, more studies are needed to identify if headache features such as episode duration are characteristic of a specific headache diagnosis.

Finally, from the studies assessing the specific region of headache, occipital headache was reported in all studies, suggesting a similarity

with CGH (Blumenfeld and Siavoshi, 2018). Furthermore, the incidence of headache in the occipital area was higher than in other locations, with one study reporting that all participants presented with a combination of frontal and occipital headache (Magnússon et al., 1996).

#### 4.2.1. Clinical and research recommendations

Heterogeneity between studies is one of the most important limitations in this review which limits the conclusions that can be drawn. Nevertheless, when managing people with WAD, it is evident that headache must be considered as one of the most common symptoms provoking high disability. This scoping review provides an overview of some of the more common characteristics of whiplash-associated headache which may assist clinicians in their clinical reasoning. Based on our findings, clinicians may consider that range of motion could be a contributing factor to headache, although more research is needed. That said, it is evident that future studies should aim to comprehensively characterize whiplash-associated headache based on a range of signs and symptoms, by combining the recognition of clinical patterns with physical signs and patient reported outcomes. Ultimately this may lead to a better understanding of whiplash-associated headache and improved treatment approaches.

## 5. Conclusion

This scoping review summarises the literature describing the clinical characteristics of whiplash-associated headache. Whiplash-associated headache intensity appears to range from mild to moderate, typically with episodes of short duration which is commonly experienced in the occipital region amongst other regions, and with a tendency to reduce in intensity over time.

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## Declaration of competing interest

None.

## Appendix A. Supplementary data

Supplementary data to this article can be found online at <https://doi.org/10.1016/j.msksp.2023.102802>.

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