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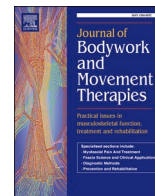
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## How do Australian osteopaths manage migraines? Outcomes from a national practice-based research network

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### ABSTRACT

**Background:** Individuals who experience migraines often seek out a variety of treatment options including manual or physical therapy. Evidence suggests that manual therapy, including osteopathy, can play a role in the management of migraines. Whilst there is some literature on the role osteopathy therapy plays in migraine management, none describes the treatment approaches used by practitioners.

**Objectives:** To explore the demographic, practice and clinical management characteristics of Australian osteopaths who report treating migraine 'often' in clinical practice.

**Methods:** Secondary analysis of a cross-sectional survey of 988 osteopaths from the Osteopathy Research and Innovation Network (ORION), an Australian practice-based research network. Regression analysis was used to identify demographic, practice and clinical management characteristics of Australian osteopaths who reported 'often' treating migraine patients.

**Results:** Over 40% of respondents (n = 400) indicated treating patients with migraines 'often'. These osteopaths were less likely to be involved in research and be co-located with a dietician compared to osteopaths who do 'not often' treat migraine. Osteopaths who reported 'often' treating migraine were: five times as likely to treat non-English speaking ethnic groups; 2.5 times as likely to treat chronic pain, temporomandibular joint disorders and hand musculoskeletal complaints; compared to those that do not treat migraines 'often'.

**Conclusion:** Australian osteopaths who treat migraine are five times more likely to treat non-English speaking ethnic groups; twice as likely to treat chronic pain; temporomandibular joint disorders, and hand musculoskeletal complaints. More research is needed to identify the practices and patient outcomes associated with osteopathy care for those experiencing migraines.

### 1. Introduction

The International Classification of Headache Disorders 3rd Edition [ICHD-III] (International Headache Society, 2018) classifies migraine as a primary headache disorder, characterised by moderate or severe headache lasting 4–72 h and usually accompanied by nausea, vomiting and/or photophobia and phonophobia. Migraine headaches are sometimes preceded by a short-lasting aura of unilateral visual, sensory or other central nervous system symptoms (International Headache Society, 2018). Migraine can be further classified according to frequency -

episodic or chronic migraine; and also by the absence or presence of aura (International Headache Society, 2018).

Migraines have a significant impact on individuals and society more broadly, and worldwide are the number one cause of disability in those aged 15–49 years, in terms of disability-adjusted life-years (DALYs) (Rich, 2019). Further, a Finnish study (Korolainen et al., 2019) reported that migraines were the largest cause of headache-related healthcare visits. Australian data suggests that approximately five million Australians suffer from migraines with 86% of sufferers being of working age, contributing to a substantial societal cost of approximately \$35.7 billion dollars (Deloitte Access Economics, 2018).

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### Abbreviations

ANS	autonomic nervous system
CI	confidence interval
OR	odds ratio
PBRN	practice-based research network
TMD	temporomandibular joint disorder
TMJ	temporomandibular joint

Migraine is frequently managed by medication, but some patients do not tolerate migraine-specific medications due to side effects or prefer to avoid medication for other reasons (Chaibi et al., 2011). Beyond medications, patients often seek care for migraines from a variety of health professionals and manual therapies such as osteopaths, appear to be a common treatment choice amongst those who suffer from migraines (Adams et al., 2018). Manual therapy appears to play a role in the wider management of migraines, (Tuchin et al., 2000; Lawler and Cameron, 2006; Zhang et al., 2017; Moore et al., 2017) with the two most commonly reported motivators for a patient seeking manual therapy care for migraines being pain relief (45–84%), and concerns regarding the safety of pharmacological-based treatment (27–53%) (Moore et al., 2018). There is an emerging literature that has examined a range of issues around the manual therapy (chiropractic) workforce and practice characteristics regarding the treatment of those with migraine and headaches (Moore et al., 2017; Moore et al., 2018; Moore et al., 2020). Similarly, there is some research exploring the effects of osteopathic treatment for headache sufferers, including migraineurs (Silva et al., 2022; Cerritelli et al., 2015a), however no research exists which explores the characteristics of osteopaths and their clinical management of migraine sufferers.

Meanwhile, osteopaths are reported to treat approximately 2.7% of the overall headache population in Australia (Moore et al., 2017). Osteopathy, with an emphasis on whole person care, is a healthcare system integrating physical examination, manual therapy techniques (e.g. manipulation, mobilisation, soft tissue techniques) and exercise and advice, for a range of musculoskeletal complaints, including headaches (Adams et al., 2018; Steel et al., 2020). Osteopathic treatment generally encompasses a diverse set of manual techniques, such as stretching of soft tissues, manipulation of the spine, resisted isometric muscle energy stretches, visceral techniques, and exercise recommendations (Franke et al., 2014, 2015, 2017). The approach to treatment emphasises a holistic perspective on the patient, and osteopathic treatment can be administered to various body regions and tissues, often extending beyond the symptomatic area based on the clinical judgment of the practitioner (Fleischmann et al., 2021).

There is emerging evidence to support the use of Franke et al., 2014, 2015, 2017 osteopathy to assist in reducing medication use, decreasing pain and improving the daily function in those with headaches, including those who experience migraines (Cerritelli et al., 2015b; D'Ippolito et al., 2017; Rist et al., 2019). Although the efficacy of osteopathy techniques applied to the musculoskeletal system are emerging, (Franke et al., 2015, 2017; Cerritelli et al., 2017) there is little describing the efficacy of osteopathy techniques for those with migraine, (Cerritelli et al., 2015b; D'Ippolito et al., 2017) and no literature describing the clinical, practice and management characteristics of osteopaths who report treating patients experiencing migraines. Given the burden migraines place on the Australian population, osteopaths may be able to play a role in alleviating costs through multidisciplinary patient care. However, no study has provided an insight into the characteristics of Australian osteopaths who manage patients with migraines. The aim of this study is to explore the clinical characteristics of Australian osteopaths who report 'often' providing osteopathy care for migraine patients.

## 2. Methods

### 2.1. Context

This study is a secondary analysis of data drawn from the Australian osteopathy practice-based research network (PBRN) (Adams et al., 2018; Steel et al., 2020). PBRNs are designed to foster research, develop practice relevant research questions, and assist in the translation of knowledge to improve clinical care (Mold and Peterson, 2005; Pirota and Temple-Smith, 2017). PBRNs have been used in Australia and internationally across the medical and allied health professions (Adams et al., 2017, 2018; Pirota and Temple-Smith, 2017; Gilbert, 2009; Hickner and Green, 2015; Selby et al., 2015).

### 2.2. Participants

Ethics approval for the data collection was granted by the University of Technology, Sydney, Human Ethics Committee (# 2,014,000,759). The ORION project (Lee et al., 2019) recruited participants from July to December 2016. At the time of the ORION recruitment there were 2020 registered osteopaths practicing in Australia and all were invited to participate in the PBRN with those consenting invited to complete an online questionnaire. Responses were received from 992 osteopaths, providing a nationally-representative sample of the Australian osteopathy profession with respect to age, gender and geographic location at the time of data collection (Adams et al., 2018).

### 2.3. Questionnaire

A 27-item questionnaire was developed to collect data from the PBRN participants using dichotomous, frequency and Likert-type responses (Adams et al., 2018). The questionnaire invited participants to provide data on individual practitioner demographics (i.e. age, gender, and number of years in private osteopathy practice), participants' practice characteristics (i.e. patient care hours and patient visits per week, practice location and interactions with other health professionals either through co-location or referrals), and patient management (i.e. body regions treated, manual therapy technique use, advice to patients). Additional items explored participant opinion on expanded practice rights and use of research in osteopathy practice. Patient management characteristics included discussion of lifestyle behaviors, frequency of treating specific patient populations, and frequency of osteopathy technique use.

### 2.4. Outcome variable and exposure variables

Participants were asked to indicate their frequency of treating migraine ('never', 'rarely', 'sometimes', and 'often') – the primary outcome variable. The outcome variable was dichotomized to 'not often' (combining never, rarely, and sometimes) or 'often'. The exposure variables were the practitioner and practice characteristics previously described. Variables with frequency or Likert-type responses were dichotomized for the analysis (*often* and *not often* ('never', 'rarely', 'sometimes') and attitude (*definitely* and *not definitely* ('no', 'unsure', 'maybe')). Variables such as age and years in practice were analysed as continuous variables. Additional variables are reported in binary form (yes/no).

### 2.5. Statistical analyses

Analyses were performed using SPSS (version 27). Descriptive statistics were generated for each variable on the questionnaire. Inferential statistics, including chi-square and t tests were used to explore association between the outcome variable and dichotomized variables. Alpha was set at  $p < 0.05$  and unadjusted odds ratios (ORc) (with 95% confidence intervals) calculated where significant. Continuous data were

analysed using independent measures t-tests with alpha set at  $p < 0.05$  and effects sizes (Cohen's  $d$ ) calculated where significant. Variables with  $p < 0.20$  were entered into a binary logistic regression analysis as per previous published investigations of this data (Fleischmann et al., 2020; Steel et al., 2019; Vaughan et al., 2020a). Backward elimination was used to determine the important predictors of osteopaths who 'often' treat migraine headaches. Adjusted odds ratios (OR) with 95% confidence intervals (CI) and p-values were calculated from this regression modelling. Variables were significantly associated with the outcome variable at  $p < 0.05$ .

### 3. Results

#### 3.1. Practitioner characteristics

Of the 992 respondents to the ORION practice questionnaire, 988 Australian osteopaths responded to the item about frequency of treating patients with migraines. Of these, 400 (40%) reported 'often' treating migraine in clinical practice. Practitioner age, gender and years in clinical practice were not significantly different between Australian osteopaths who reported often treating patients with migraines compared to the 'not often' group (Table 1). A greater mean number of patient visits and face-to-face care hours per week was observed for those Australian osteopaths who report 'often' treating patients with migraines with a medium effect size (Table 1). Australian osteopaths who reported 'often' treating migraine patients were less than half as likely (ORc 0.45) to be involved with research compared to colleagues who do 'not often' treat migraine patients (Table 1).

**Table 1**  
Demographic characteristics of Australian osteopaths who report 'often' treating migraine patients compared with those who do 'not often' treat migraine patients.

	Often (n = 400)	Not often (n = 588)	p-value	ORc [95% CI]
<b>Gender</b>				
Male	223 (55.8%)	351 (59.7%)	0.22	-
Female	177 (44.3%)	237 (40.3%)		
<b>Age (years)</b>				
Mean ( $\pm$ SD)	38.3 ( $\pm$ 10.9)	37.8 ( $\pm$ 10.8)	0.47	
<b>Years in clinical practice</b>				
Mean ( $\pm$ SD)	11.8 ( $\pm$ 9.1)	11.1 ( $\pm$ 8.8)	0.18	
<b>Patient care hours per week</b>				
Mean ( $\pm$ SD)	30.4 ( $\pm$ 11.4)	26.3 ( $\pm$ 12.2)	<0.01 <sup>a</sup>	
<b>Patient encounters per week</b>				
Mean ( $\pm$ SD)	40.7 ( $\pm$ 18.0)	33.5 ( $\pm$ 18.5)	<0.01 <sup>b</sup>	
<b>Qualification (n, %)</b>				
Diploma	23 (5.8%)	38 (6.5%)	0.64	-
Advanced Diploma	4 (1.0%)	5 (0.9%)		
Bachelor degree	97 (24.3%)	121 (20.6%)		
Master's degree	265 (66.3%)	413 (70.2%)		
PhD	2 (0.5%)	3 (0.5%)		
Other	9 (2.3%)	8 (1.4%)		
<b>Professional activities</b>				
University teaching	38 (9.5%)	78 (13.3%)	0.07	-
Clinical supervision	57 (14.2%)	93 (15.8%)	0.50	-
Professional organisations	39 (9.8%)	67 (11.4%)	0.41	-
Research	13 (3.3%)	41 (7.0%)	0.01	0.45 [0.34, 0.85]
Volunteer as an osteopath	62 (15.5%)	96 (16.3%)	0.73	-

<sup>a</sup>  $d = 0.35$ .

<sup>b</sup>  $d = 0.39$ .

Australian osteopaths who reported 'often' treating migraine patients were more likely to be co-located with a naturopath (ORc 1.44) but less likely to be co-located with a dietician (ORc 0.47), when compared to those osteopaths who reported 'not often' treating migraine patients (Table 2). Australian osteopaths who reported 'often' treating migraine patients were also more likely to report sending referrals to psychologists (ORc 1.54), naturopaths (ORc 1.34) and nutritionists (ORc 1.53) than colleagues who did 'not often' treat migraines (Table 2). With respect to receiving referrals, Australian osteopaths who reported 'often' treating migraine patients were more likely to report receiving referrals from occupational therapists (ORc 2.07), psychologists (ORc 1.71) and massage therapists (ORc 1.36) (Table 2). No significant association was observed between frequency of treating migraines and diagnostic imaging and patient assessment characteristics.

#### 3.2. Clinical management characteristics

Australian osteopaths who reported 'often' treating patients with migraines were more likely to engage in discussions with patients about a range of lifestyle, health and adjunct measures compared to osteopaths who treat this complaint on a 'not often' basis (Table 3). However, Australian osteopaths who reported 'often' treating migraine patients were less likely to provide pain counselling to patients compared to colleagues who do 'not often' treat patients with migraines (ORc 0.74) (Table 3).

When considering patient presentations, Australian osteopaths who reported 'often' treating migraine patients were more than twice as likely to report 'often' treating a range of patient presentations (excluding neck and low back pain) compared to colleagues who treat migraines on a 'not often' basis (Table 3). A similar finding was also observed for all patient subgroups, who reported treating migraine 'often' by Australian osteopaths (Table 3). Australian osteopaths who reported 'often' treating migraine patients were more likely to report agreement with seeking increased referral rights to paediatricians (OR 1.67) and rheumatologists (OR 1.32), compared to osteopaths who do 'not often' treat migraine patients (Table 3).

Logistic regression analysis identified a range of factors independently associated with Australian osteopaths who reported 'often' treating migraine patients (Table 4).

Osteopaths who reported treating migraine 'often' were twice as likely to work with a massage therapist (OR 2.02; 95%CI 1.39–2.91); 65% less likely to work with a dietician (OR 0.34; 95%CI 0.17–0.70); and approximately 80% more likely to refer to a dietician (OR 1.76; 95%CI 1.08–2.87) and refer for diagnosis (OR 1.74; 95%CI 1.04–2.94) (Table 4).

Osteopaths who reported treating migraine 'often' were more likely than those who reported treating migraine 'not often' to treat patients from a non-English speaking ethnic group (OR 4.90; 95%CI 1.48–16.20); more likely to often treat those with chronic or persistent pain (OR 2.74; 95%CI 1.80–4.18) and those with hand musculoskeletal complaints (OR 2.55, CI 1.37–4.75) or TMJ disorders (OR 2.67, CI 1.61–4.42) (Table 4).

Osteopaths who reported often treating migraine patients were twice as likely to often use Autonomic balancing (OR 2.05, 95%CI 1.10–3.81) and osteopathy in the cranial field techniques (OR 1.89, 95%CI 1.02–3.51), but less than half as likely to often use biodynamic techniques (OR 0.41, 95%CI 0.20–0.82), than those osteopaths who reported not often treating migraine patients (Table 4).

### 4. Discussion

This secondary analysis of data from the Australian osteopathy PBRN is the first to provide a picture of the clinical and practice characteristics of osteopaths who report managing migraine patients 'often'. Data from the PBRN demonstrates over 40% of a nationally representative sample of Australian osteopaths 'often' treat patients with migraine in clinical practice (Adams et al., 2018). This outcome provides support for the

**Table 2**

Practice characteristics of Australian osteopaths who report ‘often’ treating migraine patients compared with those who do ‘not often’ treat migraines.

	‘Often’ (n = 400)	‘Not often’ (n = 588)	p-value	ORc [95% CI]
<b>Practice location</b>				
Urban practice	330 (82.5%)	487 (82.8%)	0.89	–
>1 practice location	146 (36.5%)	200 (34.0%)	0.42	–
<b>Co-located with other health professionals (‘yes’)</b>				
Osteopath	260 (65.0%)	379 (64.5%)	0.86	–
General Practitioner	28 (7.0%)	43 (7.3%)	0.85	–
Specialist Medical Practitioner	12 (3.0%)	19 (3.2%)	0.84	–
Podiatrist	57 (14.2%)	89 (15.1%)	0.70	–
Physiotherapist	54 (13.5%)	88 (15.0%)	0.52	–
Exercise Physiologist	44 (11.0%)	78 (13.3%)	0.29	–
Occupational Therapist	9 (2.3%)	10 (1.7%)	0.54	–
Psychologist	79 (19.8%)	112 (19.0%)	0.78	–
Massage Therapist	216 (54.0%)	283 (48.1%)	0.07	–
Acupuncturist	81 (20.3%)	107 (18.2%)	0.42	–
Naturopath	92 (23.0%)	101 (17.2%)	0.02	1.44 [1.05, 1.97]
Dietician	18 (4.5%)	53 (9.0%)	<0.01	0.47 [0.27, 0.82]
Nutritionist	38 (9.5%)	40 (6.8%)	0.12	–
<b>Send referrals to other health professionals (‘yes’)</b>				
Osteopath	213 (53.3%)	292 (49.7%)	0.27	–
General Practitioner	361 (90.3%)	513 (87.2%)	0.15	–
Specialist Medical Practitioner	190 (47.5%)	252 (42.9%)	0.15	–
Podiatrist	264 (66.0%)	384 (65.3%)	0.82	–
Physiotherapist	136 (34.0%)	193 (32.8%)	0.70	–
Exercise Physiologist	170 (42.5%)	226 (38.4%)	0.20	–
Occupational Therapist	47 (11.8%)	59 (10.0%)	0.39	–
Psychologist	164 (41.0%)	183 (31.1%)	<0.01	1.54 [1.18, 2.00]
Massage Therapist	282 (70.5%)	388 (66.0%)	0.13	–
Acupuncturist	189 (47.3%)	262 (44.6%)	0.40	–
Naturopath	210 (52.5%)	266 (45.2%)	0.02	1.34 [1.04, 1.72]
Dietician	77 (19.3%)	89 (15.1%)	0.09	–
Nutritionist	64 (16.0%)	65 (11.1%)	0.02	1.53 [1.06, 2.22]
<b>Receive referrals from other health professionals (‘yes’)</b>				
Osteopath	261 (64.3%)	350 (59.5%)	0.07	–
General Practitioner	365 (91.3%)	517 (87.9%)	0.10	–
Specialist Medical Practitioner	104 (26.0%)	133 (22.6%)	0.22	–
Podiatrist	199 (49.8%)	271 (46.1%)	0.26	–
Physiotherapist	112 (28.0%)	152 (25.9%)	0.45	–
Exercise Physiologist	116 (29.0%)	140 (23.8%)	0.07	–
Occupational Therapist	35 (8.8%)	26 (4.4%)	<0.01	2.07 [1.23, 3.51]

**Table 2 (continued)**

	‘Often’ (n = 400)	‘Not often’ (n = 588)	p-value	ORc [95% CI]
Psychologist	79 (19.8%)	74 (12.6%)	<0.01	1.71 [1.21, 2.42]
Massage Therapist	317 (79.3%)	433 (73.6%)	0.04	1.36 [1.01, 1.85]
Acupuncturist	154 (38.5%)	215 (36.6%)	0.54	–
Naturopath	175 (43.8%)	224 (38.1%)	0.07	–
Dietician	18 (4.5%)	21 (3.6%)	0.46	–
Nutritionist	25 (6.3%)	30 (5.1%)	0.44	–
<b>Diagnostic imaging</b>				
Referral for imaging (‘often’)	37 (9.3%)	36 (6.1%)	0.06	–
Investigation of unknown pathologies	305 (76.3%)	436 (74.1%)	0.45	–
Investigation of suspected diagnosis	346 (86.5%)	485 (82.5%)	0.09	–
Investigation of potential fractures	310 (77.5%)	437 (74.3%)	0.25	–
Rule out risk factors prior to treatment	121 (30.3%)	151 (25.7%)	0.11	–
General screening of the spine	15 (3.8%)	17 (2.9%)	0.45	–
<b>Patient assessment (‘yes’)</b>				
Orthopaedic testing	389 (97.3%)	575 (97.8%)	0.59	–
Clinical assessment algorithm	188 (47.0%)	278 (47.3%)	0.93	–
Neurological testing	372 (93.0%)	542 (92.2%)	0.63	–
Screening questionnaire	256 (64.0%)	374 (63.6%)	0.90	–
Cranial nerve testing	280 (70.0%)	390 (66.3%)	0.22	–

notion that osteopaths constitute an important resource within the Australian health workforce with respect to the management of migraines. There is an emerging evidence base for the efficacy of osteopathy care for migraines and headaches (Cerritelli et al., 2017). However, osteopathy is generally not included in current clinical/practice guidelines for headache and migraine care, with consideration only given to how newer medications for example may be utilised in care (American Headache Society, 2019). Specific guidelines have been developed for the chiropractic management of headaches (Bryans et al., 2011) and it may be similar guidelines may be produced for osteopathy care of migraines, with the current work informing the development of these guidelines.

**4.1. Migraine and chronic or persistent pain**

Australian osteopaths who report treating patients with migraines ‘often’ were nearly three times more likely to report ‘often’ treating patients with chronic pain compared to their counterparts who do ‘not often’ treat migraine patients. Chronic musculoskeletal complaints are not an uncommon presentation to Australian osteopaths with nearly half of patients presenting with a chronic complaint (Burke et al., 2013; Vaughan et al., 2020b). Further, there is a high prevalence of chronic or persistent musculoskeletal pain in the community, (Pirota and Temple-Smith, 2017) and findings from a national comorbidity survey, which found patients with self-reported chronic spine pain were about five times more likely to suffer from migraine (Adams et al., 2017). This research together with the current work suggests Australian osteopaths may be involved in the management of patients with persistent migraines (and potentially concomitant spinal complaints). However, such an assertion requires additional exploration to understand the clinical presentation of patients with migraines to Australian osteopaths.

**Table 3**  
Clinical management characteristics of Australian osteopaths who report ‘often’ treating patients with migraines.

	‘Often’	‘Not often’	p-value	ORc [95% CI]
<b>Discuss with patients (‘often’)</b>				
Diet/Nutrition	188 (47.1%)	187 (31.8%)	<0.01	1.91 [1.47, 2.48]
Smoking/Drugs/Alcohol	87 (21.8%)	92 (15.6%)	0.01	1.50 [1.08, 2.08]
Physical activity/Fitness	354 (88.5%)	529 (90.0%)	0.46	–
Occupation Health & Safety	225 (56.4%)	279 (47.5%)	<0.01	1.43 [1.10, 1.84]
Pain counselling	93 (23.3%)	171 (29.1%)	0.04	0.74 [0.55, 0.99]
Stress management	220 (55.3%)	268 (45.6%)	<0.01	1.47 [1.14, 1.90]
Nutritional supplements	124 (31.0%)	128 (21.8%)	<0.01	1.61 [1.21, 2.15]
Medications	184 (46.0%)	206 (35.1%)	<0.01	1.57 [1.21, 2.04]
<b>Patient presentations (‘often’)</b>				
Neck pain	396 (99.0%)	572 (97.3%)	0.06	–
Thoracic pain	383 (95.8%)	524 (89.1%)	<0.01	2.72 [1.58, 4.77]
Low back pain	397 (99.3%)	577 (98.3%)	0.19	–
Hip MSK pain	337 (84.3%)	404 (68.8%)	<0.01	2.42 [1.75, 3.34]
Knee MSK pain	255 (63.9%)	235 (40.0%)	<0.01	2.65 [2.04, 3.44]
Ankle MSK pain	204 (51.0%)	129 (22.0%)	<0.01	3.69 [2.80, 4.87]
Foot MSK pain	175 (43.8%)	119 (20.2%)	<0.01	3.06 [2.31, 4.06]
Shoulder MSK pain	354 (88.5%)	445 (75.8%)	<0.01	2.45 [1.71, 3.52]
Elbow MSK pain	168 (42.2%)	83 (14.2%)	<0.01	4.43 [3.26, 6.01]
Wrist MSK pain	130 (32.5%)	58 (9.9%)	<0.01	4.39 [3.11, 6.18]
Hand MSK pain	93 (23.3%)	28 (4.8%)	<0.01	6.03 [3.86, 9.42]
Postural disorders	307 (76.8%)	366 (62.4%)	<0.01	1.99 [1.49, 2.65]
Degenerative spine conditions	293 (73.4%)	304 (51.7%)	<0.01	2.58 [1.96, 3.40]
Headache disorders	399 (99.8%)	491 (83.5%)	<0.01	78.82 [10.94, 567.75]
Spine health maintenance	241 (60.3%)	217 (37.0%)	<0.01	2.57 [1.98, 3.35]
Chronic or persistent pain	321 (80.3%)	308 (52.5%)	<0.01	3.68 [2.74, 4.94]

**Table 3 (continued)**

	‘Often’	‘Not often’	p-value	ORc [95% CI]
Tendinopathies	231 (57.8%)	177 (30.2%)	<0.01	3.16 [2.42, 4.13]
Temporomandibular joint disorders	133 (33.4%)	50 (8.5%)	<0.01	5.40 [3.78, 7.71]
Non-MSK disorders	83 (20.9%)	43 (7.4%)	<0.01	3.31 [2.23, 4.90]
<b>Patient subgroups (treat ‘often’)</b>				
Up to 3 years of age	82 (20.6%)	74 (12.6%)	<0.01	1.78 [1.26, 2.52]
4–18 years of age	147 (36.8%)	122 (20.8%)	<0.01	2.21 [1.66, 2.94]
Over 65 years of age	272 (68.0%)	298 (50.8%)	<0.01	2.07 [1.58, 2.67]
Aboriginal & Torres Strait Islander peoples	3 (0.8%)	4 (0.7%)	0.90	–
Pregnant women	187 (46.8%)	157 (26.7%)	<0.01	2.40 [1.84, 3.14]
Non-English speaking ethnic groups	24 (6.0%)	9 (1.5%)	<0.01	4.08 [1.88, 8.88]
Sport injuries	247 (61.9%)	251 (42.8%)	<0.01	2.17 [1.67, 2.82]
Worker injury (compensable)	54 (13.5%)	49 (8.4%)	<0.01	1.71 [1.14, 2.58]
Work injury (non-compensable)	180 (45.0%)	160 (27.3%)	<0.01	2.18 [1.67, 2.85]
Traffic injury (compensable)	29 (7.2%)	25 (4.3%)	0.04	1.74 [1.01, 3.03]
Traffic injury (non-compensable)	74 (18.6%)	39 (6.7%)	<0.01	3.20 [2.12, 4.82]
Post-surgery	55 (13.8%)	24 (4.1%)	<0.01	3.72 [2.26, 6.13]
<b>Manual therapy (use ‘often’)</b>				
Strain/Counter-strain	197 (49.4%)	222 (37.8%)	<0.01	1.60 [1.23, 2.07]
Muscle energy technique	313 (78.4%)	473 (80.4%)	0.44	–
HVLA/manipulation	265 (66.4%)	364 (61.9%)	0.15	–
Peripheral Joint manipulation	181 (45.6%)	212 (36.1%)	<0.01	1.48 [1.14, 1.92]
Soft tissue techniques	333 (83.5%)	511 (87.1%)	0.11	–
Myofascial release	260 (65.3%)	349 (59.4%)	0.06	–
Visceral techniques	60 (15.0%)	38 (6.5%)	<0.01	2.56 [1.67, 3.93]
Lymphatic pump	56 (14.0%)	28 (4.8%)	<0.01	3.26 [2.03, 5.24]
Autonomic balancing	93 (23.4%)	64 (10.9%)	<0.01	2.50 [1.76, 3.53]
Biodynamic techniques	77 (19.3%)	78 (13.3%)	0.01	1.56 [1.11, 2.20]
Functional techniques	149 (37.3%)	120 (20.4%)	<0.01	2.32 [1.75, 3.09]

(continued on next page)

**Table 3** (continued)

	'Often'	'Not often'	p-value	ORc [95% CI]
Balanced ligamentous tension	171 (42.9%)	177 (30.1%)	<0.01	1.74 [1.33, 2.27]
Chapman's reflexes	15 (3.8%)	9 (1.5%)	0.02	2.52 [1.09, 5.81]
Trigger point therapy	121 (30.4%)	136 (23.1%)	0.01	1.45 [1.09, 1.93]
Cranial techniques	124 (31.1%)	109 (18.6%)	<0.01	1.98 [1.47, 2.66]
Facilitated positional release	98 (24.6%)	68 (11.6%)	<0.01	2.49 [1.77, 3.50]
Needling techniques	109 (27.4%)	124 (21.1%)	0.02	1.41 [1.05, 1.90]
Exercise prescription	299 (74.9%)	43.1 (73.4%)	0.59	–
Shockwave therapy	10 (2.5%)	7 (1.2%)	0.12	–
Ultrasound therapy	13 (3.3%)	14 (2.4%)	0.40	–
TENS	12 (3.0%)	7 (1.2%)	0.04	2.58 [1.00, 6.61]
Instrument manipulation	1 (0.3%)	1 (0.2%)	0.78	–
Instrument soft-tissue	8 (2.0%)	4 (0.7%)	0.06	–
Sport taping	62 (15.6%)	60 (10.2%)	0.01	1.62 [1.11, 2.37]
<b>Expanded practice scope ('definitely')</b>				
Prescribing rights	111 (27.8%)	144 (24.5%)	0.24	–
Referral rights to orthopaedic surgeon	295 (73.9%)	405 (68.9%)	0.09	–
Referral rights to paediatrician	248 (62.2%)	291 (49.5%)	<0.01	1.67 [1.29, 2.17]
Referral rights to sports medicine specialist	318 (79.9%)	469 (79.8%)	0.96	–
Referral rights to rheumatologist	269 (67.4%)	358 (60.9%)	0.03	1.32 [1.02, 1.73]
Referral rights to other medical specialist	1 (0.3%)	0	0.23	–
Expanded diagnostic imaging rights	332 (83.2%)	487 (82.8%)	0.87	–
<b>Research in practice ('strongly agree')</b>				
Useful to help patients understand the benefits of osteopathy	191 (47.8%)	251 (42.7%)	0.12	–
Useful to help GPs and other conventional health professionals understand the role of osteopathy	286 (73.7%)	381 (68.0%)	0.06	–
Useful to provide scientific evidence for what I do as an osteopath	216 (55.8%)	297 (54.2%)	0.62	–
Irrelevant to the professional development of osteopathy in Australia.	243 (62.8%)	319 (58.4%)	0.17	–
Impact of research on practice ('high impact')	102 (25.5%)	136 (23.1%)	0.39	–

MSK – musculoskeletal.

**4.2. Migraine and temporomandibular joint (TMJ) disorders**

Migraine regularly occurs as a co-morbidity to TMJ disorders (TMD) (Ashraf et al., 2019; Gonçalves et al., 2010; Stuginski-Barbosa et al., 2010; Franco et al., 2010; Kang et al., 2010). Further, potential connections have been suggested between TMJ parafuncions (i.e. teeth

**Table 4**

Adjusted odds ratios (OR) for significant demographic, practice and clinical management characteristics of Australian osteopaths who reported treating migraine 'often'.

Practice characteristics ('yes')	Adjusted OR	95%CI	p-value
Patient visits per week	1.02	1.00, 1.03	<0.01
Involved in research	0.35	0.14, 0.88	0.02
Co-located with a massage therapist	2.01	1.39, 2.91	<0.01
Co-located with a dietician	0.34	0.16, 0.70	<0.01
Send referrals to a dietician	1.76	1.08, 2.87	0.02
Refer for diagnostic imaging to assist with diagnosis	1.74	1.03, 2.93	0.03
<b>Clinical management characteristics ('often')</b>			
Discuss occupational health and safety	1.57	1.04, 2.93	0.02
Discuss stress management	0.65	0.44, 0.95	0.03
Treat patients from non-English speaking ethnic groups	4.90	1.48, 16.20	<0.01
Treat hand musculoskeletal complaints	2.55	1.37, 4.75	<0.01
Treat degenerative spine complaints	1.52	1.03, 2.25	0.04
Treat chronic or persistent pain patients	2.74	1.80, 4.18	<0.01
Treat tendinopathies	1.65	1.12, 2.44	0.01
Treat temporomandibular joint (TMJ) disorders	2.67	1.61, 4.42	<0.01
Treat non-musculoskeletal disorders	2.02	1.08, 3.78	0.03
Use osteopathy in the cranial techniques	1.89	1.02, 3.51	0.04
Use autonomic balancing techniques	2.05	1.10, 3.81	0.02
Use biodynamic techniques	0.41	0.20, 0.82	0.01

grinding and clenching) and chronification of migraine (Didier et al., 2014). In the current work, Australian osteopaths who report 'often' treating migraine patients were more than twice as likely to treat the TMJ than those osteopaths who do 'not often' treat migraine patients. This finding suggests that Australian osteopaths may be directing manual therapy treatment towards the TMJ as part of migraine management - an approach consistent with the identified need to treat both migraine symptoms and TMD concurrently (Goncalves et al., 2013). Further, evidence from a number of studies suggests that osteopathy care can positively influence TMD pain intensity and pain experience (Gesslbauer et al., 2018; Cuccia et al., 2010), and decrease medication use (Cuccia et al., 2010). The survey in the current work does not allow for an exploration of the manual therapy interventions directed towards the TMJ that Australian osteopaths utilise, nor their efficacy. However, this provides an avenue for further investigation as to the efficacy of osteopathy treatment (including manual therapy applied to the TMJ) and influence on migraine symptomatology.

**4.3. Migraine and manual therapy interventions**

Several manual therapy interventions were observed to be more frequently used by Australian osteopaths who report 'often' treating migraine patients compared to osteopaths who do 'not often' treat this complaint. These manual therapy interventions included osteopathy in the cranial field (OCF) (OR 1.89) and autonomic balancing (OR 2.05). Osteopathy in the cranial field is a manual therapy intervention directed towards the structures of the skull. The aforementioned work by Cuccia,

Caradonna (Cuccia et al., 2010) suggests the OCF can positively impact the pain experience in patients with migraines, and (Mulcahy and Vaughan, 2014) reported patients feel “relaxed” with this intervention. The efficacy and mechanism of action for OCF in migraine patients requires further research however the effects of the technique may be achieved through an overall sense of relaxation. Autonomic balancing is a range of interventions with the intent of improving sympathetic and parasympathetic nervous system parameters. Growing literature points to autonomic nervous system (ANS) disorder in primary headaches, including migraine (Cuciureanu et al., 2017; Möller and May 2019; Peroutka, 2004). Further, modulation of the trigeminal autonomic reflex has been suggested as an effective migraine treatment (Möller and May 2019). These studies suggest that interventions directed towards the ANS may be beneficial. However, the reported effects of manual therapy directed towards influencing the autonomic nervous system are equivocal (Cerritelli et al., 2021; Amoroso Borges et al., 2018) and there is no literature exploring the use of these interventions on migraine symptoms. Reasoning for the choice of manual therapy interventions to influence the autonomic nervous system and their associated outcomes in migraine patients warrants additional exploration to ascertain if they are beneficial, particularly as an adjunct to medications affecting the ANS.

#### 4.4. Migraine and hand musculoskeletal disorders

Our analysis suggests that Australian osteopaths who report ‘often’ treating migraine patients were more than twice as likely to also report ‘often’ treating hand musculoskeletal disorders, when compared to those osteopaths who do ‘not often’ treat migraine patients. Currently there is no clear evidence for any definitive link between migraine and hand musculoskeletal disorders. However, a recent study found the incidence of migraine in a population with carpal tunnel syndrome (CTS) (34%) was more than double the incidence of migraine in those without CTS (Law et al., 2015). The proposed link between the two complaints is that both are thought to be compression neuropathies (Boran and Bolay, 2013; Burstein et al., 2015; Gasparini et al., 2013; Goadsby, 2012; Goadsby et al., 2017; Puleda et al., 2017). Research into the clinical reasoning of osteopaths with respect to hand and migraine disorders, and their conceptions of the anatomical and physiological basis, may assist in understanding the association observed in the current work.

#### 4.5. Migraines and multidisciplinary practice

Multidisciplinary care of migraine patients has been demonstrated to achieve superior outcomes compared to mono-disciplinary approaches (Witteveen et al., 2017; Lemstra et al., 2002). The current study identified a number of associations between Australian osteopaths who report ‘often’ treating patients with migraines and other health professionals. Australian osteopaths who report ‘often’ treating migraine patients are twice as likely to work at a practice location that includes a massage therapist when compared to osteopaths who report not often treating migraine patients. The higher likelihood of having an in-house massage therapist may be reflective of migraineurs seeking massage as a co-management treatment strategy. Massage has been found to be the second most common form of complementary and alternative medicine (CAM) used by patients with primary headache disorders in Germany, Austria (Gaul et al., 2009) and the United States (Rhee and Harris, 2018).

Although Australian osteopaths who report ‘often’ treating migraine patients were 66% less likely to work at a practice location that includes a dietician, those ‘often’ treating migraine patients were almost twice as likely to refer a patient to a dietician compared to colleagues who do ‘not often’ treat migraines. This association may reflect an appreciation amongst these osteopaths that diet-related factors are one of the known triggers of migraine attacks (Martin and Vij, 2016; Slavin and Ailani, 2017; Millstine et al., 2017; Al-kotb, 2016; Burch et al., 2019; Tai et al.,

2018) and that patients may benefit from care with a dietician. However, triggers are highly individualised and current evidence does not advocate for any diet for individuals who experience migraines (Slavin and Ailani, 2017; Orr, 2016; Zaem et al., 2016). Given this, more research to understand the circumstances under which an osteopath may refer to a dietician is necessary.

#### 4.6. Limitations

Our study has a number of limitations and it is important these are considered when interpreting our results. The survey design we utilised was based upon participants’ self-report and as such this may have introduced recall bias (Van de Mortel, 2008). Surveys are also prone to voluntary response bias and it is possible that osteopaths who are pre-disposed to research participation are more likely to respond. An individual practitioners’ conception of what clinical signs and symptoms constitute a migraine may have influenced the outcomes described here. Further work to explore these conceptions and clinical reasoning of Australian osteopaths in migraine care may refute or confirm the aforementioned issues.

### 5. Conclusion

Migraine is a significant health burden worldwide and many patients experiencing migraines choose to receive osteopathy care as part of their wider migraine management. Our analysis provides an insight into the demographic and clinical practice characteristics of the management of migraines by Australian osteopaths. This data is invaluable in informing future research into the clinical outcomes of osteopathy care for migraines and identifies a number of opportunities for additional research in clinical reasoning and efficacy, to better understand the management and manual therapy intervention choices made by osteopaths when caring for migraine patients. There is an urgent need to examine and understand the practices and role of osteopaths within the wider context of multi-disciplinary management of migraine and to identify evidence-based osteopathic treatments for the safe, effective management of migraine patients.

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#### CRediT authorship contribution statement

**Michael Fleischmann:** Writing – review & editing, Writing – original draft, Visualization, Software, Resources, Project administration, Methodology, Investigation, Formal analysis, Data curation, Conceptualization. **Brett Vaughan:** Writing – review & editing, Visualization, Validation, Methodology, Investigation, Formal analysis, Data curation, Conceptualization. **Callum Campbell:** Writing – review & editing, Writing – original draft, Methodology. **Josh Ekberg:** Writing – review & editing, Writing – original draft, Methodology. **Maya Evans:** Writing – review & editing, Writing – original draft, Methodology. **Mike Green:** Writing – review & editing, Writing – original draft, Methodology. **Adeline Ong:** Writing – review & editing, Writing – original draft, Methodology. **Gabriel Pitrone:** Writing – review & editing, Writing – original draft, Methodology. **Rebecca Lane:** Writing – review & editing, Writing – original draft, Visualization, Methodology. **Jon Adams:** Writing – review & editing, Writing – original draft, Resources,



Methodology, Data curation.

## Declaration of competing interest

The authors declare no conflicts of interest.

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## Appendix A. Supplementary data

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## References

- Adams, J., Peng, W., Steel, A., et al., 2017. A cross-sectional examination of the profile of chiropractors recruited to the Australian Chiropractic Research Network (ACORN): a sustainable resource for future chiropractic research. *BMJ Open* 7.
- Adams, J., Sibbritt, D., Steel, A., Peng, W., 2018. A workforce survey of Australian osteopathy: analysis of a nationally-representative sample of osteopaths from the Osteopathy Research and Innovation Network (ORION) project. *BMC Health Serv. Res.* 18, 352.
- Al-kotb, H., 2016. The effect of lifestyle modification program on reducing migraine disability among migraineurs suffers. *Am. J. Nurs. Sci.* 5, 280.
- American Headache Society, 2019. The American headache society position statement on integrating new migraine treatments into clinical practice. *Headache* 59, 1–18.
- Amoroso Borges, B.L., Bortolazzo, G.L., Neto, H.P., 2018. Effects of spinal manipulation and myofascial techniques on heart rate variability: a systematic review. *J. Bodyw. Mov. Ther.* 22, 203–208.
- Ashraf, J., Zaproudina, N., Suominen, A.L., Sipilä, K., Närhi, M., Saxlin, T., 2019. Association between temporomandibular disorders pain and migraine: results of the health 2000 survey. *J. Oral Facial Pain Headache* 33, 399–407.
- Boran, H.E., Bolay, H., 2013. Pathophysiology of migraine. *Noro psikiyatri arsivi* 50, S1–S7.
- Bryans, R., Descarreaux, M., Duranleau, M., et al., 2011. Evidence-based guidelines for the chiropractic treatment of adults with headache. *J. Manip. Physiol. Ther.* 34, 274–289.
- Burch, R.C., Buse, D.C., Lipton, R.B., 2019. Migraine: epidemiology, burden, and comorbidity. *Neurol. Clin.* 37, 631–649.
- Burke, S.R., Myers, R., Zhang, A.L., 2013. A profile of osteopathic practice in Australia 2010–2011: a cross sectional survey. *BMC Musculoskel. Disord.* 14, 227.
- Burstein, R., Nosedá, R., Borsook, D., 2015. Migraine: multiple processes, complex pathophysiology. *J. Neurosci.* 35, 6619–6629.
- Cerritelli, F., Ginevri, L., Messi, G., et al., 2015a. Clinical effectiveness of osteopathic treatment in chronic migraine: 3-Armed randomized controlled trial. *Compl. Ther. Med.* 23, 149–156.
- Cerritelli, F., Ginevri, L., Messi, G., et al., 2015b. Clinical effectiveness of osteopathic treatment in chronic migraine: 3-Armed randomized controlled trial. *Compl. Ther. Med.* 23, 149–156.
- Cerritelli, F., Lacorte, E., Ruffini, N., Vanacore, N., 2017. Osteopathy for primary headache patients: a systematic review. *J. Pain Res.* 10, 601.
- Cerritelli, F., Chiacchiaretta, P., Gambi, F., Saggini, R., Perrucci, M.G., Ferretti, A., 2021. Osteopathy modulates brain–heart interaction in chronic pain patients: an ASL study. *Sci. Rep.* 11, 1–15.
- Chaibi, A., Tuchin, P.J., Russell, M.B., 2011. Manual therapies for migraine: a systematic review. *J. Headache Pain* 12, 127.
- Cuccia, A.M., Caradonna, C., Annunziata, V., Caradonna, D., 2010. Osteopathic manual therapy versus conventional conservative therapy in the treatment of temporomandibular disorders: a randomized controlled trial. *J. Bodyw. Mov. Ther.* 14, 179–184.
- Cuciureanu, D.I., Constantinescu, I., Constantinescu, V., Corciova, C., Matei, D., 2017. Current perspectives on less-known aspects of headache. In: 3. Primary Headaches and Their Relationship with the Autonomic Nervous System. Intech.
- D'Ippolito, M., Tramontano, M., Buzzi, M.G., 2017. Effects of osteopathic manipulative therapy on pain and mood disorders in patients with high-frequency migraine. *J. Am. Osteopath. Assoc.* 117, 365–369.
- Deloitte Access Economics, 2018. Migraine in Australia whitepaper. In: Melbourne, Australia.
- Didier, H.A., Marchetti, A., Marchetti, C., et al., 2014. Study of parafunctions in patients with chronic migraine. *Neurol. Sci.* 35, 199.
- D'Ippolito, M., Tramontano, M., Buzzi, M.G., 2017. Effects of osteopathic manipulative therapy on pain and mood disorders in patients with high-frequency migraine. *J. Am. Osteopath. Assoc.* 117, 365–369.
- Fleischmann, M., Vaughan, B., Fitzgerald, K., Grace, S., 2020. Use of manual therapy applied to the viscera: secondary analysis of a nationally representative sample of Australian osteopaths. *Int. J. Osteopath. Med.* 36, 19–25.
- Fleischmann, M., Vaughan, B., Grace, S., et al., 2021. The use of visceral techniques in Australian osteopathic practice: a descriptive cross-sectional study. *Adv. Integr. Med.* 8, 292–297.
- Franco, A.L., Gonçalves, D.A.G., Castanharo, S.M., Camparis, C.M., Speciali, J.G., Bigal, M.E., 2010. Migraine is the most prevalent primary headache in individuals with temporomandibular disorders. *J. Oral Facial Pain Headache* 24, 287–292.
- Franke, H., Franke, J.D., Fryer, G., 2014. Osteopathic manipulative treatment for nonspecific low back pain: a systematic review and meta-analysis. *BMC Musculoskel. Disord.* 15, 286.
- Franke, H., Franke, J.-D., Fryer, G., 2015. Osteopathic manipulative treatment for chronic nonspecific neck pain: a systematic review and meta-analysis. *Int. J. Osteopath. Med.* 18, 255–267.
- Franke, H., Franke, J.-D., Belz, S., Fryer, G., 2017. Osteopathic manipulative treatment for low back and pelvic girdle pain during and after pregnancy: a systematic review and meta-analysis. *J. Bodyw. Mov. Ther.* 21, 752–762.
- Gasparini, C.F., Sutherland, H.G., Griffiths, L.R., 2013. Studies on the pathophysiology and genetic basis of migraine. *Curr. Genom.* 14, 300–315.
- Gaul, C., Eismann, R., Schmidt, T., et al., 2009. Use of complementary and alternative medicine in patients suffering from primary headache disorders. *Cephalalgia* 29, 1069–1078.
- Gesslbauer, C., Vavti, N., Keilani, M., Mickel, M., Crevenna, R., 2018. Effectiveness of osteopathic manipulative treatment versus osteopathy in the cranial field in temporomandibular disorders – a pilot study. *Disabil. Rehabil.* 40, 631–636.
- Gilbert, G.H., 2009. The role of practice-based research networks in improving clinical care: “The Dental PBRN” example. *Dent. Abstr.* 54, 284–285.
- Goadsby, P.J., 2012. Pathophysiology of migraine. *Ann. Indian Acad. Neurol.* 15, 15–22.
- Goadsby, P.J., Holland, P.R., Martins-Oliveira, M., Hoffmann, J., Schankin, C., Akerman, S., 2017. Pathophysiology of migraine: a disorder of sensory processing. *Physiol. Rev.* 97, 553–622.
- Gonçalves, D.A.G., Bigal, M.E., Jales, L.C.F., Camparis, C.M., Speciali, J.G., 2010. Headache and symptoms of temporomandibular disorder: an epidemiological study. *Headache* 50, 231–241.
- Goncalves, D.A.G., Camparis, C.M., Speciali, J.G., et al., 2013. Treatment of comorbid migraine and temporomandibular disorders: a factorial, double-blind, randomized, placebo-controlled study. *J. Orofac. Pain* 27, 325–335.
- Hickner, J., Green, L.A., 2015. Practice-based research networks (PBRNs) in the United States: growing and still going after all these years. *J. Am. Board Fam. Med.* 28, 541–545.
- International Headache Society, 2018. International classification of headache disorders 3rd edition [ICHD-III]. *Cephalalgia* 38, 1–211.
- Kang, J.K., Ryu, J.W., Choi, J.H., Kim, S.T., Merrill, R.L., 2010. Application of ICHD-II criteria for headaches in a TMJ and orofacial pain clinic. *Cephalalgia* 30, 37–41.
- Korolainen, M.A., Kurki, S., Lassenius, M.I., et al., 2019. Burden of migraine in Finland: health care resource use, sick-leaves and comorbidities in occupational health care. *J. Headache Pain* 20, 13.
- Law, H.-Z., Amirak, B., Cheng, J., Douglas, M., Sammer, D., 2015. An association between carpal tunnel syndrome and migraine headaches—national health interview survey, 2010. *Plast. Reconstr. Surg.* Global Open 3 e333–e333.
- Lawler, S.P., Cameron, L.D., 2006. A randomized, controlled trial of massage therapy as a treatment for migraine. *Ann. Behav. Med.* 32, 50–59.
- Lee, H., Peng, W., Steel, A., Sibbritt, D., Adams, J., Reid, R., 2019. Complementary and alternative medicine research in practice-based research networks: a critical review. *Compl. Ther. Med.* 43, 7–19.
- Lemstra, M., Stewart, B., Olszynski, W.P., 2002. Effectiveness of multidisciplinary intervention in the treatment of migraine: a randomized clinical trial. *Headache* 42, 845–854.
- Martin, V.T., Vij, B., 2016. Diet and headache: Part 2. *Headache* 56, 1553–1562.
- Millstine, D., Chen, C.Y., Bauer, B., 2017. Complementary and integrative medicine in the management of headache. *BMJ* 357, j1805.
- Mold, J.W., Peterson, K.A., 2005. Primary care practice-based research networks: working at the interface between research and quality improvement. *Ann. Fam. Med.* 3, S12–S20.
- Möller, M., May, A., 2019. The unique role of the trigeminal autonomic reflex and its modulation in primary headache disorders. *Curr. Opin. Neurol.* 32, 438–442.
- Moore, C., Adams, J., Leaver, A., Lauche, R., Sibbritt, D., 2017. The treatment of migraine patients within chiropractic: analysis of a nationally representative survey of 1869 chiropractors. *BMC Compl. Alternative Med.* 17, 519.
- Moore, C., Leaver, A., Sibbritt, D., Adams, J., 2018. The management of common recurrent headaches by chiropractors: a descriptive analysis of a nationally representative survey. *BMC Neurol.* 18, 171.
- Moore, C., Leaver, A., Sibbritt, D., Adams, J., 2020. The features and burden of headaches within a chiropractic clinical population: a cross-sectional analysis. *Compl. Ther. Med.* 48, 102276.
- Mulcahy, J., Vaughan, B., 2014. Sensations experienced and patients' perceptions of osteopathy in the cranial field treatment. *J. Evid. Base Complementary Altern. Med.* 2156587214534263
- Orr, S.L., 2016. Diet and nutraceutical interventions for headache management: a review of the evidence. *Cephalalgia* 36, 1112–1133.
- Peroutka, S.J., 2004. Migraine: a chronic sympathetic nervous system disorder. *Headache* 44, 53–64.
- Pirotta, M., Temple-Smith, M., 2017. Practice-based research networks. *Aust. Fam. Physician* 46, 793–795.

- Puledda, F., Messina, R., Goadsby, P.J., 2017. An update on migraine: current understanding and future directions. *J. Neurol.* 264, 2031.
- Rhee, T.G., Harris, I.M., 2018. Reasons for and perceived benefits of utilizing complementary and alternative medicine in U.S. adults with migraines/severe headaches. *Compl. Ther. Clin. Pract.* 30, 44–49.
- Rich, S.J., 2019. Burden of migraine and impact of emerging therapies on managed care. *Am. J. Manag. Care* 25, S35–S39.
- Rist, P.M., Hernandez, A., Bernstein, C., et al., 2019. The impact of spinal manipulation on migraine pain and disability: a systematic review and meta-analysis. *Headache* 59, 532–542.
- Selby, K., Cornuz, J., Senn, N., 2015. Establishment of a representative practice-based research network (PBRN) for the monitoring of primary care in Switzerland. *J. Am. Board Fam. Med.* 28, 673–675.
- Silva, C.E.J., Joseph, A.M., Khatib, M., et al., 2022. Osteopathic manipulative treatment and the management of headaches: a scoping review. *Cureus* 14.
- Slavin, M., Ailani, J., 2017. A clinical approach to addressing diet with migraine patients. *Curr. Neurol. Neurosci. Rep.* 17, 17.
- Steel, A., Vaughan, B., Orrock, P., et al., 2019. Prevalence and profile of Australian osteopaths treating older people. *Compl. Ther. Med.* 43, 125–130.
- Steel, A., Peng, W., Sibbritt, D., Adams, J., 2020. Introducing national osteopathy practice-based research networks in Australia and New Zealand: an overview to inform future osteopathic research. *Sci. Rep.* 10, 846.
- Stuginski-Barbosa, J., Macedo, H.R., Bigal, M.E., Speciali, J.G., 2010. Signs of temporomandibular disorders in migraine patients: a prospective, controlled study. *Clin. J. Pain* 26, 418–421.
- Tai, M.-L.S., Yap, J.F., Goh, C.B., 2018. Dietary trigger factors of migraine and tension-type headache in a South East Asian country. *J. Pain Res.* 11, 1255–1261.
- Tuchin, P.J., Pollard, H., Bonello, R., 2000. A randomized controlled trial of chiropractic spinal manipulative therapy for migraine. *J. Manip. Physiol. Ther.* 23, 91–95.
- Van de Mortel, T.F., 2008. Faking it: social desirability response bias in self-report research. *Aust. J. Adv. Nurs.* 25, 40.
- Vaughan, B., Fleischmann, M., Fitzgerald, K., et al., 2020a. Profile of an allied health clinical supervision workforce: results from a nationally representative Australian practice-based research network. *Health Prof. Educ.* 6, 376–385.
- Vaughan, B., Fitzgerald, K., Fleischmann, M., Mulcahy, J., 2020b. Determinants of health, health behaviours and demographic profile of patients attending an Australian university student-led osteopathy clinic. *Chiropr. Man. Ther.* 28, 2.
- Witteveen, H., van den Berg, P., Vermeulen, G., 2017. Treatment of menstrual migraine: multidisciplinary or mono-disciplinary approach. *J. Headache Pain* 18, 45.
- Zaeem, Z., Zhou, L., Dilli, E., 2016. Headaches: a review of the role of dietary factors. *Curr. Neurol. Neurosci. Rep.* 16, 101.
- Zhang, Y., Dennis, J.A., Leach, M.J., et al., 2017. Complementary and alternative medicine use among US adults with headache or migraine: results from the 2012 national health interview survey. *Headache* 57, 1228–1242.