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ORIGINAL ARTICLE

Mild Traumatic Brain Injury After Motor Vehicle Collisions: What Are the Symptoms and Who Treats Them? A Population-Based 1-Year Inception Cohort Study

Jan Hartvigsen, PhD,[a,b] Eleanor Boyle, PhD,[a] J. David Cassidy, PhD, DrMedSc,[a,c,d,e] Linda J. Carroll, PhD[f]

From the [a]Institute of Sports Science and Clinical Biomechanics, University of Southern Denmark, Odense, Denmark; [b]Nordic Institute of Chiropractic and Clinical Biomechanics, Odense, Denmark; [c]Division of Epidemiology, Dalla Lana School of Public Health, University of Toronto, Toronto, Ontario, Canada; [d]Division of Health Care and Outcomes Research, Toronto Western Research Institute, University Health Network, University of Toronto, Toronto, Ontario, Canada; [e]Institute of Health Policy, Management and Evaluation, University of Toronto, Toronto, Ontario, Canada; and [f]School of Public Health and Alberta Centre for Injury Control and Research, School of Public Health, University of Alberta, Edmonton, Alberta, Canada.

Abstract

Objective: To describe the 1-year course of symptoms following mild traumatic brain injury (MTBI) sustained in a motor vehicle collision as well as patterns of care-seeking.

Design: One-year follow-up of a population-based inception cohort.

Setting: The province of Saskatchewan, Canada, with a population of about 1,000,000 inhabitants.

Participants: Persons (N=1716) sustaining an MTBI during a car collision between November 1997 and December 1999.

Interventions: Not applicable.

Main Outcome Measures: We report the prevalence of sleep disturbances, tiredness, dizziness, forgetfulness, vision problems, hearing problems, headache, neck pain, mid back pain, and low back pain at 6 weeks and 3, 6, 9, and 12 months postcollision. At the same time points, we report self-reported care-seeking from registered health care professionals.

Results: A total of 1716 adults suffered MTBI after a motor vehicle collision over the 2-year inception period. Six weeks after the collision, 75% reported having more than 3 symptoms and 30% had clinically significant pain in more than 3 body sites. Over time, the prevalence of symptoms and pain decreased but they were still common after 1 year. Almost all participants sought care for their symptoms at all time points, most commonly from a physician. Care-seeking from physiotherapists, chiropractors, and massage therapists was also very common, and most participants sought care from 2 or 3 providers at all follow-up points.

Conclusions: Up to 1 year after sustaining an MTBI during a motor vehicle collision, multiple symptoms and pain in several anatomical sites are common. Care-seeking from multiple providers continues throughout the first year postinjury.

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While the true incidence of traumatic brain injury (TBI) and concussion is not known, it is estimated that as many as 600 of every 100,000 Americans are affected every year,[1] resulting in approximately 1.4 million visits to emergency departments yearly.[2] There is evidence that the incidence of TBI is increasing, especially during sports activities, possibly reflecting both true increase and increased reporting.[3,4]

TBI severity is usually categorized into mild, moderate, or severe, most often on the basis of the Glasgow Coma Scale

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score,[5] with the most common being mild traumatic brain injury (MTBI), also commonly known as concussion.[2] Symptoms after MTBI vary but may include headache, blurred vision, confusion, dizziness, memory problems, fatigue, and sleep difficulties to varying degrees.[6] Imaging of the brain in persons having suffered an MTBI is usually normal.[7] Most patients with MTBI recover within the first year even though a significant minority continues to report symptoms.[8] The International Collaboration on MTBI Prognosis reviewed and critically appraised the literature relating to subjective symptoms after adult MTBI and found that although self-reported symptoms such as headache and fatigue are common even after 1 year, they are not specific to MTBI but are equally present in those with other nonhead injuries.[9] For instance, Lannsjo et al[10] reported that 44% of the persons presenting to an emergency department after MTBI still had 1 or more symptoms after 3 months, most commonly fatigue, headache, and dizziness. However, it is unclear what the source population was in this and other studies, and they did not collect data on a range of symptoms such as neck and back pain.[10] This is important because many cases of MTBI are not treated at hospitals and are therefore mostly not registered in health databases.[11] Of those who do not present to hospital emergency departments, some do not seek any care[12] while others seek care for symptoms in the primary health care sector through family physicians, physiotherapists, chiropractors, massage therapists, or others for symptoms relating to MTBI.[2] Evidence suggests that persons not experiencing persistent symptoms after the injury are less likely to seek care,[13] and indeed individuals who experience a more severe TBI access health care at a much higher rate than do persons having suffered mild or moderate TBI.[14]

Allied health professions, predominantly physiotherapists, are involved in care for individuals with MTBI.[14] This may reflect guideline recommendations for the management of MTBI, which include information about the injury, how to handle common complaints, and how to cope with them, including reassurance about the good prognosis and gradual reintegration of normal activities.[15,16] Little is known, however, about the course of common symptoms during the first year after sustaining an MTBI and how these symptoms are associated with health care-seeking from both physicians and other care providers. Such information is important and a prerequisite for subsequent analytic studies examining associations between symptoms, care-seeking, and recovery and could help formulate future intervention studies.

In this article, we describe the 1-year course of symptoms following MTBI sustained in a motor vehicle collision and the primary sector care-seeking patterns for individuals who experienced MTBI. Specifically, we sought to answer the following research questions: (1) What are the symptoms after MTBI sustained in a motor vehicle collision at 6 weeks and 3, 6, 9, and 12 months after the injury? and (2) What types of care and combinations of care do persons who have sustained an MTBI in a motor vehicle collision seek at these follow-up points?

List of abbreviations:

MTBI mild traumatic brain injury
NRS numeric rating scale
TBI traumatic brain injury

Methods

Participants and setting

Between December 1, 1997, and November 30, 1999, a population-based inception cohort of all traffic injuries in persons 18 years and older was formed in the province of Saskatchewan, Canada. The cohort included all injured individuals who were treated by registered health professionals, who were obliged to make a claim to receive reimbursement for treatment, or individuals who made an insurance claim independent of the health care provider. We excluded individuals who made such a claim more than 42 days after their injury. We also excluded individuals who had died as a result of the collision, could not answer the baseline questionnaire because of language or serious disease or injury, and Workers' Compensation claims, which are covered by a different public insurance scheme. Baseline information was collected on insurance claim forms on all subjects. This included sociodemographic characteristics, collision-related factors, injury-related symptoms, body areas with pain and intensity of the pain, depressive symptoms, health care provision, comorbid health conditions, general health, previous injury, and work status. MTBI cases were identified using a 3-step process: first the person had to answer "yes" to the question "Did you hit your head in the collision?" Then, the person had to answer either "yes" or "don't know" to one of the following questions: "Did you lose consciousness immediately after the accident?" "Immediately after the accident, did you experience amnesia or loss of memory?" "Immediately after the accident, did you experience disorientation or confusion?" In addition, the study participant had to have answered "yes" to at least one of the following questions for cohort inclusion: "Did the accident cause dizziness or unsteadiness?" "Did the accident cause memory problems or forgetfulness?" "Did the accident cause concentration of attention problems?" We excluded study participants who reported that they lost consciousness for more than 30 minutes after the collision.

Subjects were followed by computer-aided telephone interviews at 6 weeks and 3, 6, 9, and 12 months. For this study, we examined the health care utilization patterns and symptoms starting at the 6-week follow-up because the baseline questionnaire was answered any time from the day of collision to 42 days after the collision. Study participants who completed the baseline questionnaire later would have had more opportunity to visit different types of health care providers than study participants who completed the questionnaire within a couple of days of the collision. The Research Ethics Board of the University of Saskatchewan and the University of Alberta approved the original study. The University Health Network at the University of Toronto approved our current analysis.

Variables

Symptom variables at baseline included answers to the following question: "Did the accident cause any of the following symptoms?" Checklist response options included the following: sleep problems, concentration and attention problems, dizziness or unsteadiness, memory problems or forgetfulness, sleep problems, hearing problems, or vision problems. Depression was assessed at baseline using the Centre for Epidemiological Studies—Depression Scale. The Centre for Epidemiological Studies—Depression Scale, which has been shown to have good test-retest reliability and validity, was

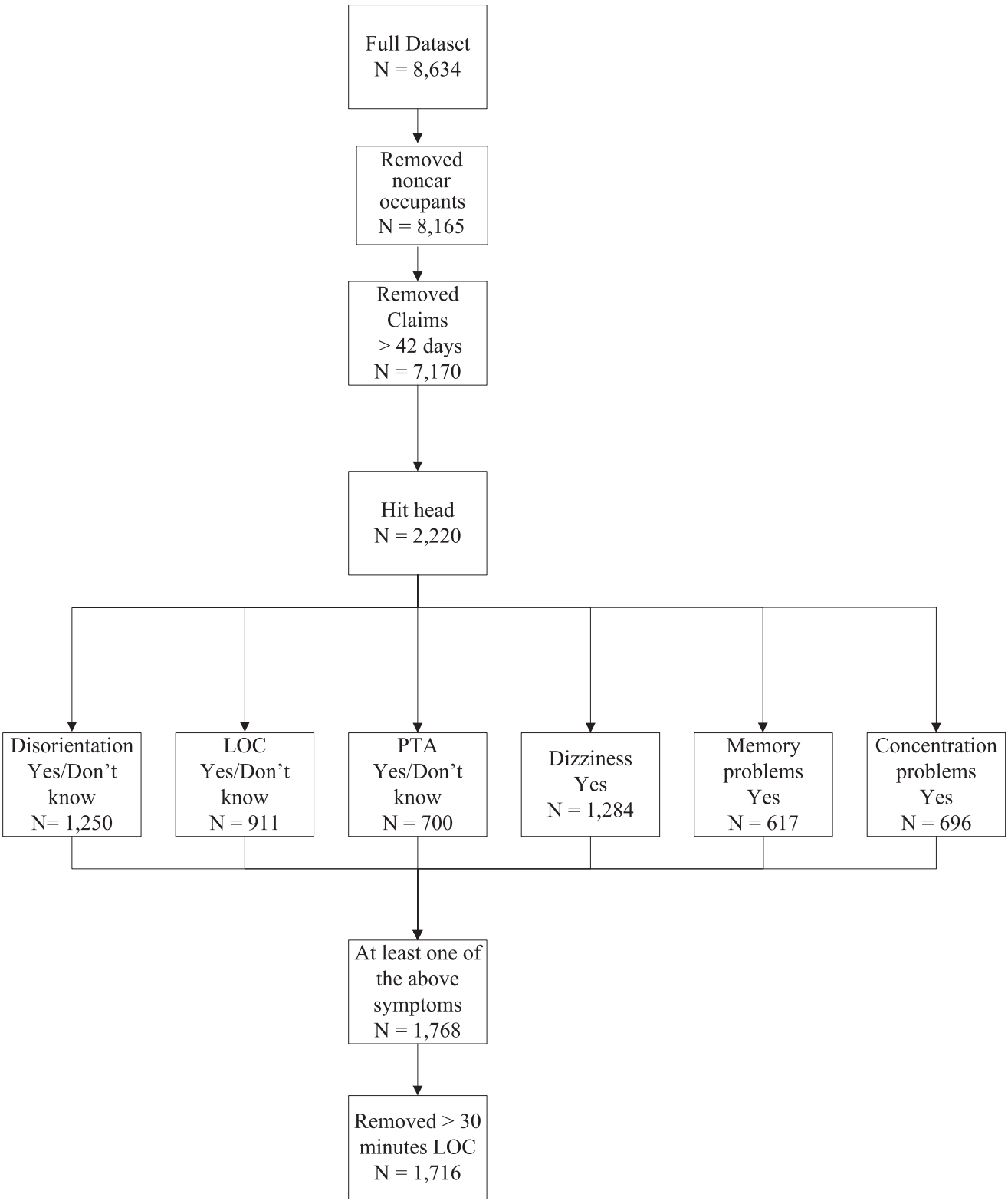

Fig 1 Flow diagram of cohort assembly.

designed to measure the current level of depressive symptoms in the general population with a score range of 0 to 60, where a higher score indicates greater depressive symptoms. The Centre for Epidemiological Studies—Depression Scale asks questions with reference to the past week, and we used a cutoff of 16 points to define depression.[17,18] This cutoff point has been used previously in population-based studies of patients with whiplash injury.[19] Self-rated health was assessed at baseline and follow-up by asking the

Table 1 Descriptive characteristics for an inception cohort of 1716 persons who sustained MTBI during a car collision

Characteristic	n (%)
Sex: female	904 (52.7)
Age (y), mean ± SD	37.7±16.1
18–23	435 (25.4)
24–29	258 (16.0)
30–39	359 (20.9)
40–49	304 (17.7)
≥50	360 (21.0)
Education	
Less than high school	520 (30.3)
High school graduate	434 (25.3)
More than high school	761 (44.4)
Missing	1 (0.0)
Income ($)	
0–20,000	625 (37.2)
20,001–$40,000	513 (30.6)
40,001–$60,000	298 (17.8)
≥60,000	242 (14.4)
Missing	38 (2.2)
Driver of the car	1215 (70.8)
Days in hospital (d), mean ± SD	1.6±4.1
0	1249 (73.0)
1–2	175 (10.2)
3–7	175 (10.2)
>7	113 (6.6)
Missing	4 (0.0)
Accident caused	
Fracture any bones	
No	1263 (73.6)
Yes	362 (21.1)
Uncertain	90 (5.3)
Missing	1 (0.0)
Loss of consciousness	
No	855 (50.0)
Yes	473 (27.6)
Do not know	386 (22.5)
Missing	2 (0.0)
Amnesia	
No	1059 (61.7)
Yes	393 (22.9)
Do not know	264 (15.4)
Confusion	
No	505 (29.5)
Yes	1019 (59.5)
Do not know	190 (11.1)
Missing	2 (0.0)
Pain intensity baseline, mean ± SD*	
Neck	6.1±2.9
Headache	5.7±3.4
Back	4.1±3.6
Mid back	3.8±3.6
Arm	3.1±3.5
Hand	1.7±2.9
Abdomen, chest, groin	3.2±3.7
Face	2.4±3.4
Leg	3.2±3.6
Foot	1.1±2.6
Prior health	
Excellent	738 (43.0)
Very good	567 (33.0)
Good	332 (19.3)
Fair/poor	79 (4.6)
Health now	
Excellent/very good	154 (9.0)
Good	385 (22.4)
Fair	682 (39.8)
Poor	494 (28.8)

* Item missing for pain questions up to 25 (1.5%).

following question: "In general would you say your health is: excellent; very good; good, fair; poor?" Headache and spine pain were assessed by asking the following question: "Did the accident cause headache, neck pain, shoulder pain, mid back pain, or low back pain?" If the answer was yes to any one of the separate questions, participants were asked to rate their pain on an 11-point numeric rating scale (NRS), where 0 was labeled as "no pain" and 10 was labeled as "pain as bad as could be."

At 3, 6, 9, and 12 months, the same questions regarding depression, symptoms, headache, neck/shoulder, mid back, and low back pain were asked in relation to the past week.

Care-seeking at the first follow-up interview at 6 weeks was assessed by asking the following question: "Since the accident, have you seen health care practitioners?" Response options were as follows: No, yes physician, yes physiotherapist, yes chiropractor, yes massage therapist, or yes other. At the 3-, 6-, 9-, and 12-month follow-up, care-seeking was assessed by asking about provider type: "Have you seen a physician or chiropractor or physiotherapist or massage therapist or any other health care provider as a result of the accident since the last follow-up?" Response options for each provider type were "yes" and "no."

Analysis

Proportions of participants with symptoms were tabulated for each follow-up time point. Pain measured from the NRS is reported as means and SDs. To distinguish trivial from nontrivial pain, we arbitrarily dichotomized answers into intensity of pain less than 5 and intensity of pain 5 or more on the NRS. We then reported proportions of participants in each category and proportion of participants with pain intensity of 5 or more at more than 3 body sites. Care-seeking from physicians, physiotherapists, chiropractors, massage therapists, and others was calculated at each follow-up point as well as the number of providers and the most common combinations of providers if more than 1 provider had been seen. Finally, symptom profiles for participants seeking care from the different providers were tabulated. The analysis was purely descriptive, and no statistical comparisons were performed.

Results

In total, 8634 persons were involved in a motor vehicle collision during the study period. We excluded 469 persons because they were not occupants of a motor vehicle (eg, pedestrians or bikers),

Table 2 Symptoms up to 1y for 1716 persons who had suffered an MTBI during a car collision

Symptoms	6wk (n=1442)	3mo (n=1415)	6mo (n=1321)	9mo (n=1193)	12mo (n=1158)
Sleep disturbances	921 (64.5)	729 (53.2)	613 (48.0)	498 (44.3)	480 (44.4)
Tiredness	845 (59.2)	721 (52.7)	573 (45.1)	457 (40.7)	426 (39.4)
Dizziness	554 (38.9)	441 (32.2)	358 (28.2)	290 (25.8)	275 (25.4)
Forgetfulness	468 (32.8)	443 (32.2)	378 (29.8)	310 (27.6)	288 (26.6)
Depression	463 (27.0)	371 (21.6)	280 (16.3)	224 (13.1)	209 (12.2)
Vision problems	276 (19.3)	232 (16.9)	208 (16.4)	178 (15.9)	156 (14.4)
Hearing problems	167 (11.7)	165 (12.1)	150 (11.8)	126 (11.2)	111 (10.3)
Headache*	540 (38.8)	373 (27.4)	305 (23.9)	234 (20.7)	207 (18.6)
Neck pain*	706 (50.0)	508 (36.9)	394 (30.7)	327 (28.5)	283 (25.4)
Mid back pain*	265 (18.6)	175 (12.7)	129 (10.0)	97 (8.4)	87 (7.8)
Low back pain*	487 (34.7)	376 (27.4)	273 (21.4)	248 (21.7)	209 (18.8)

NOTE. Values are presented as n (%).
* ≥5 on the NRS.

and a further 995 were excluded because they claimed an injury more than 42 days after the collision. To form our cohort, we identified 1768 subjects who answered "yes" to having hit their head in the collision and reported having at least 1 of the following symptoms as the result of the collision: confused, passed out, amnesia, dizziness, forgetfulness, or concentration problems. We then excluded 52 study participants who stated that they lost consciousness for more than 30 minutes. The final MTBI cohort had a sample size of 1716 (fig 1). The total follow-up rate over the duration of the study was 84%.

The mean age of the cohort was 37.7 years, and 53% were women (table 1). Slightly under a third reported that they had not completed high school, and 68% reported their income to be less than or equal to $40,000 per year. A majority of the cohort members were the driver of the car, and 27% had spent at least 1 day in hospital postcollision. Most reported that their current health status was fair to poor after the collision, which contrasted remarkably with their self-reported health status 1 year earlier, which they classified as either excellent to very good.

Six weeks after the collision, the most common symptoms were sleep disturbances (65%), tiredness (59%), neck pain (50%), headache (39%), dizziness (39%), and low back pain (35%), whereas the other symptoms were somewhat less common (table 2). Three-fourths reported more than 3 symptoms, and 26% reported

Table 3 Care-seeking over the first year for 1716 persons who had suffered an MTBI during a car collision

	6wk (n=1420)	3mo (n=1367)	6mo (n=1134)	9mo (n=1116)	12mo (n=1078)
No care	22 (1.5)	23 (1.7)	37 (3.3)	50 (4.5)	59 (5.5)
All contacts*					
MD	1364 (95.9)	1312 (95.7)	1188 (93.8)	1042 (93.0)	988 (91.4)
PT	592 (41.7)	641 (46.8)	679 (53.8)	618 (55.4)	606 (56.2)
DC	282 (19.9)	356 (26.2)	390 (30.9)	373 (33.4)	375 (34.7)
MT	346 (24.4)	393 (28.7)	385 (30.5)	382 (34.2)	370 (34.4)
Other	143 (10.1)	162 (11.8)	174 (13.8)	149 (13.3)	133 (12.3)
Care only from					
MD	425 (29.9)	341 (24.9)	275 (24.3)	209 (18.7)	194 (17.9)
PT	4 (0.2)	6 (0.4)	3 (0.3)	6 (0.5)	10 (0.9)
DC	16 (1.1)	16 (1.2)	8 (0.7)	8 (0.7)	12 (1.1)
MT	1 (0.1)	1 (0.1)	5 (0.4)	1 (0.1)	2 (0.2)
Other	0	4 (0.3)	2 (0.2)	1 (0.1)	0
Combinations of care					
MD + PT	310 (21.8)	326 (23.8)	256 (22.6)	238 (21.3)	201 (18.6)
MD + DC	85 (5.9)	85 (6.2)	68 (5.9)	59 (5.3)	61 (5.7)
MD + MT	111 (7.8)	94 (6.9)	52 (4.6)	64 (5.7)	51 (4.7)
PT + DC	1 (0.1)	0	4 (0.4)	1 (0.1)	2 (0.2)
PT + MT	0	0	3 (0.3)	0	1 (0.1)
DC + MT	10 (0.7)	6 (0.4)	5 (0.4)	7 (0.6)	7 (0.6)
MD + PT + DC	176 (12.4)	58 (4.2	77 (6.8)	75 (6.7)	78 (7.2)
PT + DC + MT	2 (0.1)	1 (0.1)	1 (0.1)	2 (0.1)	0
Missing	22 (1.5)	48 (3.5)	187 (16.4)	77 (6.9)	80 (7.4)

NOTE. Values are presented as n (%).
Abbreviations: DC, chiropractor; MD, physician; MT, massage therapist; PT, physiotherapist.
* Denominator = everyone who completed at least 1 question at a follow-up.

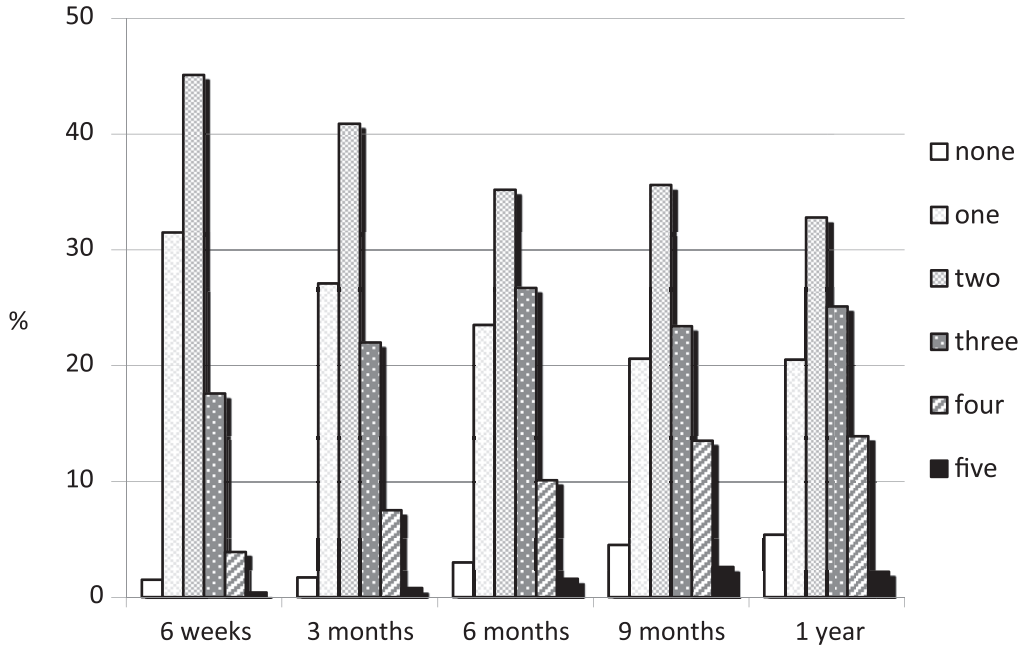

Fig 2 Number of health care providers over 1 year for 1716 individuals who had experienced MTBI after a motor vehicle collision.

more than 8 symptoms. Thirty percent had a pain score of 5 or more on the NRS at more than 3 body sites. Over time, the prevalence of all symptoms decreased. However, after 1 year, sleep disturbances (44%), tiredness (39%), forgetfulness (27%), dizziness (25%), neck pain (25%), and low back pain (19%) were still common symptoms that participants related to the collision. More than half still reported more than 3 symptoms, and 17% reported more than 8 symptoms. The number of pain sites decreased considerably over time, and only 10.5% reported a pain score of 5 or more on the NRS at more than 3 body sites at the 1-year follow-up.

Almost all participants had sought care for symptoms related to the collision within the first 6 weeks: 95.9% had seen a physician, 41.7% a physiotherapist, 19.9% a chiropractor, 24.4% a massage therapist, and 10.1% had seen another type of provider (table 3). Over the 1 year, care-seeking from physicians remained constant and high (>90%) and care-seeking from physiotherapists, chiropractors, massage therapists, and others increased. After 1 year, 74% of the participants had sought care from more than 1 provider. If participants had only 1 care provider, this was by far most commonly a physician. The majority of the participants received care from more than 1 provider at all time points, with most still seeing 2 or 3 providers after 1 year (fig 2). The most common combination of caregivers was a physician and a physiotherapist at all time points. Combinations not involving physicians were rare (see table 3), and less than 1% reported not having seen a physician at any follow-up point. Generally, a greater proportion of persons seeking care from nonphysicians reported symptoms at all time points, and this was particularly pronounced for neck pain but was true for practically all symptoms at all follow-up time points (table 4).

Discussion

To our knowledge, this is the first population-based study describing the prevalence and development of self-reported symptoms and care-seeking in individuals who have experienced a traffic-related MTBI. Being involved in a motor vehicle collision and sustaining an MTBI has a significant negative effect on a person's health status. One year later, multiple symptoms are very common and the majority (74%) continues to seek care from multiple providers. Physicians provide most of the care, but patients may also seek care from allied health professionals such as physiotherapists, chiropractors, and massage therapists. Individuals seeking care from allied health professionals have in general more symptoms than do persons seeking care from physicians. The symptom profile of this cohort is comparable to known symptom profiles from other studies of MTBI after traffic collisions[20]; however, the course and persistence of symptoms during the first year has not been mapped in detail before.

Motor vehicle collisions can result in multiple injuries and various symptoms that are similar to MTBI. For example, mechanical injury and stress to the neck and spine can also cause headache, fatigue, concentration problems, and other symptoms similar to MTBI.[21] Certainly, there can be overlap and whiplash injuries have a substantial effect on future health in terms of persistent headache, spine pain, fatigue, and sleep disturbances[22] and other pain complaints.[23] It is possible that MTBI could be caused by sudden acceleration-deceleration of the head during motions similar to whiplash injury. However, the extent of MTBI caused by indirect injury is not known in our study or in general. Differentiating symptoms of MTBI from whiplash injury is a major challenge because they probably co-occur in many cases. Also, depression is common after whiplash injury,[24] and the prevalence of both depression and spine pain decreased in our cohort over the first year after sustaining an MTBI (see table 2). Finally, in another publication based on this cohort, ratings of self-rated health were found to decrease dramatically after sustaining an MTBI in a traffic collision.[25]

We found that almost all participants received continuous care over the first year from primarily a physician, but a large proportion also consulted allied health professionals such as physiotherapists, chiropractors, and massage therapists. These providers

Table 4 Symptoms per provider up to a year for 1716 persons who had suffered an MTBI during a car collision*

	6wk				
Symptoms	Physician (n=1364)	Physiotherapist (n=592)	Chiropractor (n=282)	Massage therapist (n=346)	Other (n=143)
Sleep disturbances	891 (65.2)	431 (72.8)	202 (71.6)	233 (67.3)	107 (74.8)
Tiredness	814 (59.7)	395 (66.7)	190 (67.4)	223 (64.4)	94 (65.7)
Dizziness	529 (38.9)	269 (45.5)	120 (42.6)	134 (38.7)	75 (52.4)
Forgetfulness	447 (32.8)	220 (37.2)	114 (40.4)	133 (38.4)	60 (41.9)
Depression	445 (32.6)	223 (37.7)	99 (35.1)	121 (35.0)	65 (45.5)
Vision problems	266 (19.5)	126 (21.3)	58 (20.6)	74 (21.4)	44 (30.8)
Hearing problems	160 (11.7)	76 (12.8)	42 (14.9)	44 (12.7)	20 (13.9)
Headache*	521 (39.4)	272 (47.4)	127 (47.0)	160 (47.2)	67 (48.2)
Neck pain*	674 (50.1)	343 (58.7)	183 (65.8)	223 (65.0)	79 (55.3)
Mid back pain*	259 (19.1)	130 (22.1)	66 (23.5)	77 (22.3)	31 (21.7)
Low back pain*	471 (35.2)	234 (40.1)	124 (45.3)	143 (41.8)	57 (39.9)
	6mo				
	Physician (n=1188)	Physiotherapist (n=679)	Chiropractor (n=385)	Massage therapist (n=390)	Other (n=174)
Sleep disturbances	583 (49.1)	401 (59.1)	227 (58.9)	221 (56.7)	108 (62.1)
Tiredness	550 (46.3)	364 (53.6)	198 (51.4)	194 (49.7)	104 (59.8)
Dizziness	342 (28.8)	222 (32.7)	133 (34.5)	127 (32.6)	75 (43.1)
Forgetfulness	364 (30.7)	231 (34.0)	137 (35.6)	134 (34.4)	79 (45.4)
Depression	270 (22.7)	171 (25.2)	102 (26.5)	95 (24.4)	65 (37.4)
Vision problems	198 (16.7)	129 (18.9)	69 (17.9)	60 (15.4)	47 (27.0)
Hearing problems	141 (11.9)	84 (12.4)	56 (14.5)	38 (9.7)	25 (14.4)
Headache*	291 (24.9)	201 (29.9)	112 (29.6)	118 (30.9)	69 (40.4)
Neck pain*	370 (31.4)	271 (40.2)	164 (42.3)	159 (41.2)	74 (42.8)
Mid back pain*	124 (10.5)	95 (14.1)	58 (15.1)	41 (10.5)	32 (18.5)
Low back pain*	257 (21.9)	183 (27.3)	112 (29.5)	93 (24.3)	52 (29.9)
	12mo				
	Physician (n=988)	Physiotherapist (n=606)	Chiropractor (n=375)	Massage therapist (n=370)	Other (n=133)
Sleep disturbances	453 (45.9)	316 (52.1)	186 (49.6)	194 (52.6)	80 (60.2)
Tiredness	401 (40.6)	278 (45.9)	166 (44.2)	170 (46.1)	68 (51.1)
Dizziness	255 (25.8)	171 (28.2)	101 (26.9)	105 (28.5)	50 (37.6)
Forgetfulness	273 (27.7)	179 (29.5)	115 (30.7)	109 (29.5)	55 (41.4)
Depression	194 (19.6)	132 (21.8)	69 (18.4)	70 (18.9)	35 (26.3)
Vision problems	153 (15.5)	99 (16.3)	56 (14.9)	64 (17.3)	27 (20.3)
Hearing problems	99 (10.0)	67 (11.1)	44 (11.7)	46 (12.5)	15 (11.3)
Headache*	196 (20.2)	137 (23.1)	82 (22.3)	97 (26.5)	43 (33.6)
Neck pain*	268 (27.4)	192 (32.2)	133 (36.0)	141 (38.6)	54 (40.1)
Mid back pain*	85 (8.7)	64 (10.7)	45 (12.1)	43 (11.7)	21 (15.8)
Low back pain*	201 (20.7)	144 (24.2)	99 (26.8)	94 (25.7)	40 (30.1)

NOTE. Some patients use more than 1 provider. Values are presented as n (%).
* ≥5 on the NRS.

likely provide symptomatic treatments for back pain, neck pain, and headaches (see table 4). Consulting health care providers is dependent on many factors including habits, preferences, access, financial ability/insurance systems, and of course type and severity of injuries and symptoms. Notably, frequent attendance in family practice has been associated with psychological distress in patients,[26] and indeed emotional distress and personality changes have been found in persons who sustained a head injury in a car collision.[27] Using our same Saskatchewan data, Carroll et al[24] found that almost half of the individuals in a cohort who had experienced whiplash injury could be classified as depressed shortly after the accident and that approximately 20% had recurrent or persistent depressive symptoms.[19] In addition, the personal perception of one's injury and its potential negative consequences have been shown to significantly affect the persistence of symptoms.[28] In fact, persons who expect to get better after the collision recover more than 3 times faster than do persons who never expected to get better after a whiplash injury.[29] At the same time, evidence suggests that general practitioners underestimate the degree of patient distress in the postinjury period.[30] Thus, a greater focus on depression, emotional distress, and patient expectations instead of on bodily symptoms may result in less seeking of care and faster recovery.

There is an urgent need for clinical trials that evaluate the effectiveness of interventions that are provided to patients with MTBI by both medical and allied health professionals. Clearly, these interventions need to target a broad range of symptoms that are not unique to MTBI. Furthermore, it could be helpful

to coordinate care among various health professionals who target these conditions.

Study limitations

Our findings must be interpreted in light of several potential limitations. We formed our cohort of patients with MTBI without using the Glasgow Coma Scale. We did include subjects who had "hit their head" during the traffic collision and experienced at least 1 common MTBI symptom. However, these symptoms are not specific to MTBI and our cohort likely included some patients with whiplash injury to the neck. However, as previously discussed, distinguishing MTBI from whiplash injury is problematic because they can share the same mechanism of injury and the same symptoms. In addition, symptoms may vary across time points and patients. Furthermore, symptom reporting and care-seeking behaviors are highly affected by cultural and societal factors and our findings may not be generalizable to other settings. Because both symptoms and health care use were so frequent, we did not perform further analyses of symptom and care-seeking patterns for subgroups of participants based on personal or injury characteristics. Such analyses would require further stratification and multivariate analysis. Our data are 15 years old, and although we are not aware of any secular trends in the treatment and prognosis of MTBI, this is a potential limitation. Finally, definitions of MTBI are known to vary across studies and our findings may not be comparable to other studies that use clinician-defined MTBI. However, there is great variation in definitions of MTBI and we have addressed this issue in a companion article in this issue of the journal.[31]

An important strength of our study is that it is population based and includes all treated MTBIs after traffic collisions. Although we had no data from clinical examinations, we did have an impressive spectrum of self-reported outcomes on a large number of patients followed frequently over 1 year. Our questions came from valid measures of symptoms, which limit information bias. Our follow-up rate of 84% limits the potential for selection bias.

Conclusions

In this first population-based inception cohort study of individuals who have experienced an MTBI during a car collision, we found a high prevalence of multiple symptoms and pain at several body sites. In addition, care-seeking from multiple providers continued throughout the first year postinjury. Studies investigating how clusters of symptoms interact and affect prognosis are needed. Most urgently however, high-quality clinical trials investigating the effectiveness and cost-effectiveness of the many kinds of treatments given to these patients are needed.

Keywords

Brain concussion; Cohort studies; Health care seeking behaviour; Rehabilitation

Corresponding author

Jan Hartvigsen, PhD, Institute of Sports Science and Clinical Biomechanics, University of Southern Denmark, Campusvej 55, DK-5230 Odense M, Denmark. *E-mail address:* jhartvigsen@health.sdu.dk.

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