

G. J. Versteegen  
J. Kingma  
W. J. Meijler  
H. J. ten Duis

## Neck sprain not arising from car accidents: a retrospective study covering 25 years

Received: 26 May 1997  
Revised: 17 December 1997  
Accepted: 10 January 1998

G. J. Versteegen (✉) · W. J. Meijler  
Paincentre,  
Department of Anaesthesiology,  
University Hospital Groningen,  
PO Box 30.001,  
9700 RB Groningen, The Netherlands  
Tel. +31-50-3619317;  
fax +31-50-3619317;  
e-mail g.j.versteegen@anest.azg.nl

J. Kingma · H. J. ten Duis  
Department of Surgery,  
University Hospital Groningen,  
Groningen, The Netherlands

**Abstract** During the 25-year period 1970–1994, 680 patients were diagnosed with neck sprain due to causes other than car accidents at the Emergency Room of the University Hospital Groningen. The purpose of the present study was to analyse the prevalence, groups at risk and trends in patients with neck sprain. We defined the population as patients diagnosed with neck sprain that was not due to a car accident (NCA). The binominal test was used to obtain measures of statistical significance,  $\Delta$  was used to obtain both the total increase in the number of neck sprain victims over the whole period (1970–1994) and the relative contribution of successive 5-year periods. Over the 25-year period a steady increase in the number of patients was observed from 55 in 1970–1974 to 241 in 1990–1994. The highest

prevalence was found among 15- to 19-year-olds (3.92 per 10,000), followed by 10- to 14-year-olds (3.40 per 10,000). The major causes of neck sprain NCA were accidental falls (25%), sports injuries (24%) and bicycling injuries. Across the life span, the male: female ratio was 0.63. Ten percent of patients were treated as inpatients. The increase in neck sprain NCA can be only partly attributed to increased media attention. The reduction of working hours resulting in more leisure time activities, which in turn increases the exposure time in at risk situations, and the awareness of both patients and physicians is discussed.

**Key words** Neck sprain · Whiplash · Non car accidents · Life span · Prevalence

### Introduction

Neck sprain has usually been associated with car accidents. Widespread attention has been paid to neck sprain because of the enormous increase in the whiplash-associated disorders (WAD) due to car accidents, especially over the last decades [1, 6, 9, 19, 34, 41]. However, neck sprain is not only caused by car accidents.

The diagnostic rubric “sprains and strains of the neck” from the International Classification of Diseases (ICD-9 CM) from the World Health Organization is used by the majority of hospital-based trauma registries. Whiplash is a component of this diagnostic rubric and, according to

Penning [26], the primary mechanism of whiplash trauma is a hypertranslation of the head. In contrast to the enormous bulk of whiplash literature, as far as we know, only a few studies have focused on neck sprain. Going back to 1970, we retrieved 19 studies from Medline [21] about neck sprain, of which 9 were about neck sprain due to car accidents [3, 7, 11, 13, 14, 32, 38, 40, 42] and 3 were about neck sprain due to sports injuries [5, 18, 35]. The remaining seven studies, in which the aetiology is unclear, describe treatment and research methods [4, 12, 15, 20, 23, 37, 39]. Research results from 1970 were based on data from hospital registries in which no distinction was made between inpatients and outpatients. As far as we know there are no studies analysing trends in neck sprain

**Table 1** Prevalence rates per 10,000 inhabitants and the number of patients diagnosed with sprain of the neck not due to a car accident (NCA) treated at the University Hospital Groningen over successive five-year periods between 1970 and 1994 ( $n = 680$ )

	1970–1974	1975–1979	1980–1984	1985–1989	1990–1994	Total
No. of patients	55	100	131	153	241	680
Prevalence	0.65	1.23	1.59	1.82	2.85	1.63 <sup>a</sup>

<sup>a</sup> Average prevalence

**Table 2** Contribution of each successive 5-year period to the overall rise in the number of victims with sprain of the neck NCA between 1970 and 1994

	1975–1979	1980–1984	1985–1989	1990–1994	Total
	24.2%	16.7%	11.8%	47.3%	100%

injuries not due to car accidents (NCA), nor on the aetiology and extent (prevalence) of neck sprain NCA.

The purpose of the present study was to investigate trends and the aetiology in patients diagnosed with neck sprain NCA who were treated at the Department of Traumatology at the University Hospital Groningen during the period 1970–1994. The second concern was to analyse prevalence rates and to ascertain groups at risk (gender, age).

## Materials and methods

This 25-year retrospective study (1970–1994) involved all patients diagnosed with sprain of the neck according to the International Classification of Diseases (ICD-9, CM) whose injuries were not caused by car accidents and who attended the Emergency Room of the Department of Traumatology at the Groningen University Hospital ( $n = 680$ ). The University Hospital Groningen is a 1056-bed centre situated in the north of The Netherlands, serving a population of approximately 2 million people, which is about 93% of the catchment area. The Groningen area represents one-third of the total area of the Netherlands. The Accident and Emergency Department is freely accessible and maintains a 24-h service. All trauma visits of both inpatients and outpatients are recorded on a standardised chart. Each case record comprises patient identification, external cause of injury, comorbidity, trauma diagnoses, use of alcohol, therapeutic procedures and other treatment characteristics. The direction of forces was not registered because of the different types of injuries. Specific litigation problems are not known at the time of treatment in the Emergency Room. All patient maps were reviewed and completed by staff traumatologists. Sprain and strain of the neck was defined according to the N-code of the 8th and 9th revision (code 847.0) of the International Classification of Diseases, which has been the same for the last 25-years [22]. We defined the population as patients diagnosed with sprain of the neck not caused by a car accident (NCA). The binominal test was used to obtain measures of statistical significance. The probability  $P < 0.05$  was taken as the level of statistical significance. The total increase ( $\Delta x$ ) in the number of patients over the whole period was ascertained by determining the difference between the prevalence rate in 1970–1974 and that in 1990–1994. The relative contribution of successive 5-year periods to the overall increase from 1970 to 1994 was also determined.

## Results

During the period 1970–1994 1374 patients were diagnosed with neck sprain, of whom 51% ( $n = 694$ ) were vic-

**Table 3** Number of patients from Groningen with sprain of the neck NCA and the average prevalence rates per 10,000 inhabitants, by age group, during the period 1970–1994 ( $n = 680$ )

Age group	No. of patients	Prevalence rates
0–4	15	0.67
5–9	30	1.34
10–14	82	3.4
15–19	131	3.92
20–24	133	2.24
25–29	82	1.81
30–34	54	1.73
35–39	41	1.65
40–44	29	1.34
45–49	18	0.9
50–54	14	0.71
55–59	15	0.77
60–64	7	0.37
65–69	7	0.4
70+	22	0.59
Total	680	1.63 <sup>a</sup>

<sup>a</sup> Average prevalence

tims of car accidents and 49% ( $n = 680$ ) of other types of accident (NCA). The total number of victims diagnosed with sprain of the neck NCA increased four-fold during the period 1970–1994 (Table 1). The greatest augmentation was observed from 1985.

Prevalence rates (the number of neck sprain NCA victims per 10,000 inhabitants in the catchment area) were presented for successive 5-year periods from 1970 to 1994 (Table 1). An upwards trend in the prevalence rates was observed (from 0.65 in 1970–1974 to 2.85 in 1990–1994; a more than four-fold increase. Comparing the contribution of each successive five-year period to the total increase between the initial period and the final period, the greatest rise (47%) was observed in the last period, 1990–1994 (Table 2).

The groups at highest risk were found to be 15- to 19-year-olds (prevalence 3.92 per 10,000) followed by 10- to 14-year-olds (3.40 per 10,000) (Table 3). In contrast, we found that by employing absolute numbers only, as in

**Table 4** Number of patients with sprain of the neck NCA treated at the University Hospital Groningen by cause and age group during the period 1970–1994 ( $n = 680$ )

Cause	Age group								Total	Percentage
	0–9	10–19	20–29	30–39	40–49	50–59	60–69	70+		
Accidental fall	23	37	36	25	15	11	7	16	170	25%
Sports	8	69	63	17	5	2	0	0	164	24%
Bicycle (driver or passenger)	2	23	30	14	8	7	6	2	92	14%
Motorbike (driver or passenger)	0	28	15	5	2	3	0	0	53	8%
Violence	1	9	14	5	6	1	0	0	36	5%
Delayed effect of the accident	3	3	8	10	1	1	0	0	26	4%
Moped (driver or passenger)	0	3	10	1	1	1	0	1	17	3%
Falling object	2	5	5	4	1	0	0	0	17	3%
Pedestrian	1	3	4	1	2	1	1	3	16	2%
Other	5	33	30	13	6	2	0	0	89	12%
Total	45	213	215	95	47	29	14	22	680	100%

**Table 5** Number of patients with sprain of the neck NCA treated at the University Hospital Groningen during the period 1970–1994, according to the extent of injuries – single (neck sprain only) or multiple – and whether they were treated as inpatients or outpatients

Injury category	Inpatients		Outpatients		Total	
	<i>n</i>	%	<i>n</i>	%	<i>n</i>	%
Single	16	25%	343	56%	359	53%
Multiple	49	75%	272	44%	321	47%

most research on neck sprain, 20- to 24-year-olds ( $n = 133$ ) would be considered the group at highest risk, followed by 15- to 19-year-olds ( $n = 131$ ).

Turning to the specific causes of neck sprain NCA, accidental falls and sports were found to be the major causes (respectively, 25% and 24%) followed by bicycle injuries (14%). This “top 3”, together with injuries from motorcycle accidents and violence, are responsible for 76% of all neck sprain NCA injuries (Table 4).

The incidence over the whole age range showed a male predominance (statistically significant  $Z$ -values ranged from 2.2 to 3.6  $P < 0.05$ ). However, concerning injury caused by accidental fall, in the age group 70 years and older both an increase in the number of victims and a female predominance was observed. Neck sprain due to sports was diagnosed only in patients below the age of 40 (95%).

Alcohol was present in 5% ( $n = 32$ ) of neck sprain victims, 75% of whom were male and 50% of whom were aged between 20 and 29.

With regard to the time of the accident, a peak was observed between 14.00 and 16.00 hours, and in the months of June, August and October (total 32%). However, no peak days of the week were found.

The majority of the victims with neck sprain NCA (90%) were treated as outpatients ( $n = 615$ ) (Table 5), 65

(10%) were treated as inpatients. Thirty percent ( $n = 20$ ) of inpatients had suffered an accidental fall, 20% ( $n = 13$ ) a bicycle accident and 14% ( $n = 5$ ) a sports injury. The percentage of neck sprain NCA inpatients who also had other injuries (75%) is statistically greater than the percentage of outpatients diagnosed with both sprain of the neck NCA and other injuries ( $Z = 10$ ,  $P < 0.05$ ). These results indicate that the severity of Injury was significantly greater in inpatients than in outpatients.

## Discussion

The results of the present study, which covered a time period of 25 years, showed that sprain of the neck not due to car accidents (NCA) is a phenomenon that should not be underestimated. Although substantial research has gone into neck sprain caused by car accidents, we found that about 50% of cases of neck sprain were caused by other types of accident. These results are in agreement with findings from previous research on neck sprain due to car accidents [2, 10, 16, 24, 25, 28–31, 36]. The increase in cases of neck sprain due to car accidents may be attributed to three interacting factors: the increase in the number of cars per inhabitant during the 25-year period, the increase in the average number of kilometres driven per car and, more recently, the media [41]. Over the last decade the media has paid a lot of attention to the whiplash phenomenon. As a consequence, both patients and physicians have become more aware of neck pain (or whiplash-associated disorders), so more neck complaints are being recognized. Recently, it has been shown that the media may affect the number of diagnosed cases of neck sprain due to car accidents. Schrader et al. [34] found that diagnosed cases of whiplash-associated disorders (WAD) and their long-term consequences were less extensive in newly independent Lithuania than in western countries. No other significant differences were found between the Lithuanian

victims of rear end collisions and a control group (same complaints in sex-matched and age-matched group) in headache, neck and lower back pain, cognitive dysfunction and psychological disorders. The substantial increase in neck sprain NCA found in the present study mirrors a similar strong increase in neck sprain due to car accidents [41]. This indicates that, in our series, the media may also have played an important role in increases in diagnosed neck sprain not due to car accidents, since the greatest rise (47% of the 25-year total) occurred over the last 5 years of the study. However, it is questionable whether the media alone is responsible for the enormous rise in neck sprain NCA diagnose. During the 25-year period there were other interacting factors. From 1970, changes in society occurred, like the gradual reduction in the number of working hours per week, resulting in more leisure time [8], which in turn may have increased participation in sports and other leisure activities. Furthermore, during the same period compulsory education was extended; this also increased the exposure time in at risk situations, because participation in school gymnastics is mandatory [27]. The rising trend in neck sprain NCA may be attributed to all three interacting factors.

Except for the research of the Quebec Task Force [36] and Versteegen et al. [41], only rough estimations are available for prevalence rates of whiplash-associated disorders due to car accidents. So far, only numbers of victims per age group were determined as groups at risk in the neck sprain literature. In our study, analysis of number of patients with neck sprain NCA per age group showed that 15- to 24-year-olds were most at risk. In contrast, the results of prevalence rates showed that 10- to 19-year-olds were at highest risk. Our study included the whole life span, enabling us to show that about 16% of cases are excluded if only persons aged 18–55 are included, as in most research on neck sprain due to car accidents [28–31]. Moreover, restricting the age range results in wrong identification of the group at highest risk. Only by presenting prevalence rates across the life span is it possible to correctly identify 10- to 14-year-olds, 15- to 19-year-olds and women aged 70 years and older as the groups at highest risk.

The main cause of neck sprain NCA was found to be accidental falls (25%), followed by sports injuries (24%)

and bicycle injuries. In general, our study showed a male predominance (statistically significant). This result is not in agreement with findings from previous research on whiplash-associated disorders due to car accidents [2, 10, 16, 24, 25, 28–31, 36], in which a female predominance has been shown. A possible explanation for these different results may be attributed to our research having covered the life span over a period of 25 years. Furthermore, the aetiology was different. In our research we looked separately at neck sprain victims who had suffered a car accident and those who had met with other types of accident.

In 5% of neck sprain NCA victims (mostly male) alcohol was present. In 20% of victims of neck sprain caused by violence, alcohol was present. It is well known that alcohol is a disinhibiting factor for aggressive behaviour [17]. Peak risk times were between 14.00 and 16.00 hours and in the months of June, August and October. Holidays, resulting in more leisure time activities, may be an explanation for the peak months.

The present study employed hospital-based registries of both inpatients and outpatients who attended the Emergency Room almost directly after their accident. As far as we know, no differentiation was made between inpatients and outpatients in previous studies on neck sprain due to car accidents or on neck sprain NCA. Although the majority (90%) of victims with neck sprain NCA were outpatients, it remains unclear whether outpatients as well as inpatients develop whiplash-associated disorders. The increase in the number of patients with neck sprain arising both from car accidents and from other types of accident was mostly found in the outpatients.

The results of the present study show that hospital-based registries are useful sources of information about the development of the neck sprain epidemic over a period of 25 years. The upwards trend in neck sprain NCA demonstrated in our study is alarming, because this group (half of all victims with neck sprain) receives very little attention.

**Acknowledgements** This research was supported by a grant from the ministry of Health, Welfare and Sports (VWS). The authors appreciate the help of Hendrik Jan Nyman with the data management.

## References

1. Allen MJ, Barnes MR, Bodiwala GG (1985) The effect of seat belt legislation on injuries sustained by car occupants. *Injury* 16: 471–476
2. Balla JI (1982) The late whiplash syndrome: a study of an illness in Australia and Singapore. *Culture, Med Psychiatry* 6: 191–210
3. Bourbeau R, Desjardins D, Maag U, Laberge-Nadeau C (1993) Neck injuries among belted and unbelted occupants of the front seat of cars. *J Trauma* 35: 794–799
4. Braakman M, Braakman R (1987) Hyperflexion of cervical spine. Follow-up of 45 cases. *Acta Orthop Scand* 58: 388–393
5. Culpepper MI, Niemann KMW (1983) High school football injuries in Birmingham, Alabama. *South Med J* 76: 873–878
6. Deans GT, Magalliard JN, Kerr M, Rutherford WH (1987) Neck sprain – a major cause of disability following car accidents. *Injury* 18: 10–12
7. Deans GT (1986) Incidence and duration of neck pain among patients injured in car accidents. *BMJ* 292: 94–95
8. Dorenbos J, Schepers T, Vissers A (1985) Research on labour and the reduction of working hours (in Dutch). OSA report no. 8. Social Sciences Catholic College, Tilburg

9. Ellertson AB, Sigurjónsson K, Thorsteinsson T (1978) Clinical study of 100 patients after whiplash injury. *Icelandic Med J* 6: 25–31
10. Ettlin TM, Krischka U, Reichmann S, et al (1992) Cerebral symptoms after whiplash injury of the neck: a prospective clinical and neuropsychological study of whiplash injury. *J Neurol Neurosurg Psychiatry* 55: 943–948
11. Farbman AA (1973) Neck sprain. Associated factors. *JAMA* 26: 1010–1015
12. Foo D, Rossier AB, Cochran TP (1984) Complete sensory and motor recovery from anterior spinal artery syndrome after sprain of the cervical spine. A case report. *Eur Neurol* 23: 119–123
13. Galasko CSB, Murray PM, Pitcher M, et al (1993) Neck sprains after road traffic accidents: a modern epidemic. *Injury* 24: 155–157
14. Gebhard JS, Donaldson DH, Brown CW (1993) Soft-tissue injuries of the cervical spine. *Orthop Rev [Suppl]*: 9–17
15. Goodman BW (1988) Neck pain. *Prim Care* 15: 689–708
16. Jónsson H, Cesarini K, Sahlstedt B, Rauschnig W (1994) Findings and outcome in whiplash-type neck distortions. *Spine* 19: 2733–2743
17. Kingma J, Klasen HJ (1994) Trends in the use of alcohol in different categories of trauma victims in the period 1970–1994 (in Dutch). *Tijd Alcohol Drugs Psychotrope Stoffen* 20: 201–256
18. Larson BJ, Davis JW (1995) Trampoline-related injuries. *Bone Joint Surg Am* 77: 1174–1178
19. Magnússon T (1994) Extracervical symptoms after whiplash trauma. *Cephalalgia* 14: 223–227
20. Martino F, Ettore GC, Cafaro E, Macarini L, Bancale R, Sion E (1992) Muscle-tendon echography in acute cervical sprain traumas. Preliminary results. *Radiol Med* 83: 211–215
21. Medline (1995) CD-rom version 4.1. EBSCO, Birmingham
22. Oskam J, Kingma J, Klasen HJ (1995) The Groningen trauma study. Injury patterns in a Dutch trauma centre. *Eur J Emergency Med* 22: 37–42
23. Pache T (1989) Diagnosis of severe neck sprain and its treatment. *Rev Mod Suisse Romande* 109: 607–611
24. Parmar HV, Raymakers R (1993) Neck injuries from rear impact road traffic accidents: prognosis in persons seeking compensation. *Injury* 24: 75–78
25. Pearce JMS (1992) Whiplash injury: fact or fiction? *Headache Q Curr Treat Res* 3: 45–49
26. Penning L (1994) Hypertranslation des Kopfes nach hinten: Teil des Schleuderverletzungsmechanismus der HWS? *Orthopaede* 23: 268–274
27. Postma A (ed) (1989) *Education Act* (in Dutch). Kluwer, Deventer
28. Radanov BP, Dvorak J, Valach L (1992) Cognitive deficits in patients after soft tissue injury of the cervical spine. *Spine* 17: 127–131
29. Radanov BP, Di Stefano G, Schnidrig A, Sturzenegger M (1989) Psychosocial stress, cognitive performance and disability after common whiplash. *J Psychosom Res* 73: 1–10
30. Radanov BP, Di Stefano G, et al (1994) Common whiplash: psychosomatic or somatopsychic? *J Neurol Neurosurg Psychiatry* 57: 486–490
31. Radanov BP, Stuzenegger M, et al (1995) Long-term outcome after whiplash injury. *Medicine* 74: 281–299
32. Robinson DD, Cassar-Pullicino VN (1993) Acute neck sprain after road traffic accident: a long term clinical and radiological review. *Injury* 24: 79–82
33. Rutherford WH (1995) The medical effects of seat belt legislation in the United Kingdom. Department of Health and Social Security, London
34. Schrader H, Obelieniene D, Bovim G, et al (1996) Natural evolution of late whiplash syndrome outside the medico-legal context. *Lancet* 347: 1207–1211
35. Sohl P, Bowling A (1990) Injuries to dancers. Prevalence, treatment and prevention. *Sports Med* 9: 317–322
36. Spitzer WO, Skovron ML, Salmi LR, et al (1995) Scientific monograph of the Quebec Task Force on whiplash-associated disorders. *Spine* 20: S10–48
37. Sun FX, Tang QY, Zhu J (1988) Treatment of 242 cases of neck sprain by electric stimulation of acupoints. *Tradit Chin Med* 8: 285
38. Taylor JR, Finch PM (1993) Acute injury of the neck: anatomical and pathological basis of pain. *Ann Acad Med Singapore* 22: 187–192
39. Taylor JR, Finch PM (1993) Neck sprain. *Aust Fam Phys* 22: 1623–1625, 1627, 1629
40. Taylor JR, Twomey LT (1993) Acute injuries to cervical joints. An autopsy study of neck sprain. *Spine* 18: 1115–1122
41. Versteegen GJ, Kingma J, Meijler WJ, Ten Duis HJ (1998) Neck sprain in patients injured in car accidents: a retrospective study covering the period 1970–1994. *Eur Spin J* 7: 195–200
42. Walz F (1994) Biomechanical aspects of injuries of the cervical vertebrae. *Orthopaede* 23: 262–267
43. Wroble RR, Albright JP (1986) Neck and low back injuries in wrestling. *Clin Sports Med* 5: 295–325