Young Children with A Minor Traumatic Head Injury: Clinical Observation or CT Scan?

Nicky Niele (✉ n.niele@amsterdamumc.nl)

Amsterdam UMC - Locatie AMC: Amsterdam UMC Locatie AMC <https://orcid.org/0000-0002-4854-3608>

Frans B. Plötz

Tergooiziekenhuizen Locatie Blaricum

Ellen Tromp

Antonius Hospital: Antonius Zorggroep

Bart Boersma

Noordwest Ziekenhuisgroep

Maarten Biezeveld

OLVG Locatie Oost: OLVG

Matthijs Douma

Westfries Hospital: Dijklander Ziekenhuis

Katja Heitink

UMC Utrecht: Universitair Medisch Centrum Utrecht

Gavin ten Tusscher

Westfries Hospital: Dijklander Ziekenhuis

Hans B. van Goudoever

Amsterdam UMC - Locatie AMC: Amsterdam UMC Locatie AMC

Marlies A. van Houten

Spaarne Hospital: Spaarne Gasthuis

Research Article

Keywords: computed tomography scan, guidelines, observation, pediatric minor traumatic head injuries

Posted Date: February 18th, 2022

DOI: <https://doi.org/10.21203/rs.3.rs-1263616/v1>

License: © ⓘ This work is licensed under a Creative Commons Attribution 4.0 International License.

[Read Full License](#)

Young children with a minor traumatic head injury: clinical observation or CT scan?

Nicky Niele^{1,2}, e-mail: n.niele@amsterdamumc.nl, Frans B. Plötz^{1,2}, e-mail: fbplotz@tergooi.nl, Ellen Tromp³, e-mail: ellen.tromp@kpnmail.nl, Bart Boersma⁴, e-mail: b.boersma@nwz.nl, Maarten Biezenveld⁵, m.h.biezeveld@olvg.nl, Matthijs Douma⁶, e-mail: m.r.douma@westfriesgasthuis.nl, Katja Heitink⁷, e-mail: k.m.j.heitink-polle@umcutrecht.nl, Gavin ten Tusscher⁸, e-mail: g.tentusscher@westfriesgasthuis.nl, Hans B. van Goudoever², e-mail: h.vangoudoever@amsterdamumc.nl, Marlies A. van Houten⁹, e-mail: MvanHouten2@spaarnegasthuis.nl

Name of Department(s) and Institution(s):

- 1). Department of Pediatrics, Tergooi Hospital, Blaricum;
- 2). Amsterdam UMC, University of Amsterdam, Emma Children's Hospital, Department of Pediatrics, Amsterdam;
- 3). Department of Epidemiology and Statistics, St Antonius Hospital, Nieuwegein.
- 4). Department of Pediatrics, Noordwest Ziekenhuisgroep, Alkmaar
- 5). Department of Pediatrics, OLVG, Amsterdam
- 6). Department of Emergency Medicine, Dijklander Ziekenhuis, Hoorn
- 7). Department of Pediatrics, Flevo Ziekenhuis, Almere, current affiliation: Princess Maxima Center for Pediatric Oncology, Utrecht
- 8). Department of Pediatrics, Dijklander Ziekenhuis, Hoorn
- 9). Department of Pediatrics, Spaarne Gasthuis, Haarlem en Hoofddorp;

Address for correspondence: Nicky Niele, MD, Amsterdam UMC, University of Amsterdam, Emma Children's Hospital, Department of Pediatrics, Amsterdam, Meibergdreef 9, 1105AZ Amsterdam, The Netherlands, +31-619022487 email: n.niele@amsterdamumc.nl

Abstract:

Purpose: In young children with minor traumatic head injuries (MTHI) classified as intermediate risk (IR) either clinical observation or computed tomography (CT) scan is recommended. In this study we describe clinicians' choice and which factors contribute to this decision.

Methods: This was a planned sub-study of a prospective multicentre observational study that enrolled 1,006 children younger than 18 years with MTHI who presented to six emergency departments in The Netherlands.

Results: Of those, 280 children classified as IR group fulfilling one or more minor criteria, leaving the clinician with the choice between clinical observation or a CT scan. In our cohort 228/280 (81,4%) children were admitted for clinical observation, 15/280 (5,4%) received a CT scan, 6/280 (2,1%) received a CT scan and were admitted for observation, and 31/280 (11,1%) children were discharged from the emergency department without any intervention. Three objective factors were found in favour for a CT scan; namely age above two years, the presence of any loss of consciousness (LOC) and presentation on weekend days.

Conclusion: In children with MTHI in an IR group, clinicians prefer clinical observation above performing a CT scan.

Key words: computed tomography scan; guidelines; observation; pediatric minor traumatic head injuries

Introduction

Clinical decision rules have been developed to guide clinicians in their management of children with minor traumatic head injury (MTHI) [1–4]. In young children with MTHI

classified as high risk a computed tomography (CT) scan is recommended to rule out significant intracranial pathology, whereas for young children classified as intermediate risk (IR) either clinical observation or CT scan is recommended [1, 4]. Both clinical observation and performing a CT scan of the head have several advantages and disadvantages. A CT scan is fast and painless and as described earlier it is the golden standard to detect intracranial abnormalities after MTHI. Although the risk of clinically important brain injury in children in the IR group is low in the presence of one isolated risk factor. This risk increases with multiple risk factors, hence favouring the choice for a CT scan [5]. However, there are several concerns such as radiation related malignancies later in life, detection and clinical interpretation of non-specific findings, and the possible need for sedation in this age group. Clinical observation avoids the aforementioned side effects but is associated with higher health care costs [6]. Furthermore, there is no current consensus on the duration of observation and literature on the psychological and financial effect of separation of family during clinical observation is also lacking.

Although literature on clinician's choice is scarce, some data suggest clinicians prefer clinical observation rather than performing a CT scan in this young patient population. This could be due to subjective factors such as clinical experience of the clinician or parental preferences [7, 8]. Objective factors remain indistinct, where factors such as age of the child and type of primary attending physician are suggested [8, 9]. Other objective factors favouring a CT scan could hypothetically be several clinical parameters including timing of emergency department presentation. A better insight in these objective factors could provide more unambiguity for clinicians in emergency department management [7].

Aim of this study is twofold. First, we describe clinicians' choice between clinical observation and CT scan in young children with MTHI in an IR group. Secondly, we describe

which factors could contribute to this decision. This knowledge may help us to create more insight and optimize our Dutch national guidelines.

Methods

Study design and patients: This was a planned sub-study of a prospective multicentre observational study that enrolled 1,006 children younger than 18 years with MTHI who presented to six emergency departments in The Netherlands [10].

Guidelines: The Dutch national guidelines define several major and minor clinical criteria, specified by three age categories, namely under the age of two, between two and five years and six years and older [4]. For children under the age of six, a CT scan was recommended if they fulfilled one or more major criteria. If a child met one or more minor criteria, they were placed in an IR group and the clinician had the choice between a CT scan or clinical observation [4].

Data analysis: For the primary outcome, a comparison was made between the number of CT scans and the number of clinical observations in children under the age of six. The comparison was performed for the IR group, in which the choice was between a CT scan or clinical observation. For those 280 selected patients, the following data were extracted to evaluate which objective factors contribute to this choice: age, gender, Glasgow Coma Scale (GSC) at presentation, presence of any loss of consciousness, abnormalities at physical examination, time of day at injury, time of day at emergency department presentation, weekday or weekend day, primary responsible specialism (pediatrician, neurologist, surgeon, emergency physician or other) and trauma mechanism.

Statistical analyses: All statistical analyses were performed using SPSS version 22.0 (IBM Corp, New York, NY, USA). Kruskal-Wallis Test was conducted to examine the differences in actual emergency department management (CT scan, observation, CT scan and observation or discharge). If a statistical difference was found a Mann-Whitney U test was conducted for pairwise comparisons.

Ethical statement: The study protocol for the original database study was approved by the Medical Ethics Review Committee North Holland (reference number NH014.229, registration number M014-040).

Results

Patient population:

In our original cohort 1,006 children younger than 18 years with MTHI were enrolled of whom 672 children were younger than six years of age. Of those 672 children, 280 (41.7%) classified as IR group fulfilling one or more minor criteria, leaving the clinician with the choice between clinical observation or a CT scan.

Clinical observation vs CT scan

In our cohort 228/280 (81,4%) children were admitted for clinical observation, 15/280 (5,4%) received a CT scan, 6/280 (2,1%) received a CT scan and were admitted for observation, and 31/280 (11,1%) children were discharged from the emergency department without any intervention.

Objective factors

In our cohort the majority of children were admitted for clinical observation. We therefore looked at factors which were in favour to perform a CT scan. We found three factors (Table

1). First, there was a statistically significant difference in emergency department management depending on age group ($p < 0.001$). Relatively more isolated CT scans were performed in the older age group (10/59, 16.9% in children aged 3-5 y) in comparison with the younger age group (4/37, 10.8% in children aged 2-3 y; 1/83, 1.2% in children aged 1-2 y; none of children <1 y received a CT scan). Second, the day of presentation during weekend days children more often received a CT scan (7/189, 3.7% weekdays; versus 8/91, 8.8% weekend days). Third, a CT scan was more often performed in the presence of any LOC, namely in 5 of the 31 (16.1%), versus 10/248 (4.0%) in the absence of any LOC.

All other objective data showed no statistical difference between the decision for a CT scan or clinical observation.

Discussion

This is the first study to report clinical observation and CT rates in children with MTHI in an IR group, favouring clinical observation in this young age group. In addition, we show three objective factors in favour of a CT scan, namely age above two years, the presence of any LOC and presentation on weekend days.

The preference for observation in the very young age group could be due to historical concerns of radiation exposure in this group. Young infants are more susceptible to radiation-related malignancies than adults and have a longer lifespan to express late effects. Overall average medical radiation effective dose has increased up to seven fold over the last decades [11]. Therefore, children should be scanned with the lowest dosage as possible if a head CT scan is warranted. Present CT imaging protocols of the head in children deliver 0.6 to 2.0 mSv [12] in effective radiation dose to the head. This is lower than the current range of background radiation exposure, raising the question if this is still clinically relevant. In total, 120 new paediatric brain tumours are diagnosed each year in the Netherlands [13]. A nationwide study performed in 168.000 paediatric patients, who received one or more head CT scans between

1979 and 2012, found that the decade after the first head CT scan, one excess case per 10.000 head CT scans is estimated to occur [14]. Annually, more than 12.000 children are seen in Dutch emergency departments with MTHI [4] of which 3,300 estimated ($280/1,006 \times 12,000$) are under age of six and classify as IR. If clinicians would prefer a CT scan in all of these children, this would lead to one brain tumour every three years, a notable contribution to the total amount of paediatric brain tumours.

Clinical observation does not have this risk, but uniform execution is difficult since there is no consensus on the duration of clinical observation. Historically the length of stay varied between 12 to 48 hours after trauma. In 1999, the American Academy of Pediatrics recommended that duration of observation would extend at least 24 hours to look for signs of neurologic deterioration, but could be accomplished in any location (ED, hospital, or at home) [15]. Deterioration is typically due to increased intracranial pressure from either an expanding intracranial hematoma or cerebral oedema. Epidural hematomas are rare, but associated with a lucid interval after which symptoms develop [16]. In a retrospective cohort of more than 17.500 children with MTHI no child had a diagnosis of intracranial haemorrhage more than 6 hours after trauma, suggesting that the vast majority will become apparent in this period [17]. According to the American Academy of Pediatrics recommendation the national practice guideline advises to observe children for 24 hours. Regarding the pathophysiology and aforementioned literature strategies of some clinics to discharge children 6 hours after trauma with careful instructions for parents or guardians can be defended.

Secondly, we showed three objective factors in favour of a CT scan, namely age above two years, the presence of any LOC and presentation on weekend days. Until now, there has been no literature on objective factors and emergency department management in young children in an IR group with MTHI. Overall, it has been previously described that type of primary attending physician and race or ethnicity are associated with performing head CT

scans [8, 18]. Performing more CT scans in the older children could be due to practical feasibility which is difficult in the young child together with radiation exposure risk. Secondly, the preference for CT scanning in the presence of any LOC seems obvious. Nevertheless, all paediatric guidelines for MTHI incorporate this risk factor differently. Our Dutch guidelines and the PECARN rule define LOC as an IR, and thereby leave the choice between observation or performing a CT scan to the clinician [1, 4]. The CHALICE guideline adds a time factor, advising to perform a CT scan if the witnessed LOC exists longer than five minutes [2]. The Canadian guidelines do not define LOC as a risk factor, but as part of the definition for MTHI [3]. This raises the question whether isolated LOC is a solitary risk factor for intracranial traumatic brain injury. Literature states that this is a high-risk factor in adults, but not in children. Hereby, classifying it as an IR risk factor is a safe choice, but it is understandable that clinicians prefer a CT scan over observation [19, 20]. The final described objective factor favouring CT scan is presentation of the young child on weekend days. In the literature this last phenomenon is called the “weekend” effect. In adults with traumatic head injury a higher mortality rate has been described during the weekends. However mechanisms up until now behind this effect must still be determined [21]. Evidence for this phenomenon in children with MTHI is lacking. One could hypothesize that CT scanning is first choice or more often chosen due to the current hospitalisation capacity especially during the weekends or the absence or presence of certain specialties during weekend hours.

Although we highlighted three objective factors in favour of a CT scan, we did not examine the rational for this preference, therefore making it difficult to incorporate them in current guidelines. Yet, it would be preferable to provide clinicians better tools to make a solid choice between observation or CT scan in this large group of children. Namely up to 50% of young children under six years of age with MTHI classify as IR [22]. Literature shows there are several subjective factors guiding the decision of clinicians, for example clinical

experience of the clinician [7] and parental preference [23]. Natale et al. showed that regardless of the risk for clinically important traumatic head injury, parental anxiety and request was a common factor influencing clinicians decision, especially in children of white non-Hispanic race/ethnicity [18]. This has also been shown by Ishida et al. In nearly 40% of children in a low-risk group for intracranial abnormalities a CT scan was performed if parents “favoured” one. In contrast to only 2% of children in this risk group if the decision was deferred to the clinician [23]. In addition to reduce CT scans, Hess and colleagues showed that shared decision making led to more knowledge, less decisional conflict for parents, and better involvement than usual care [24]. It also endorsed greater trust in their clinicians. We would recommend incorporating shared decision making in our current guidelines to incorporate family preferences into decision-making algorithms when the course of action for children with MTHI is not unambiguous.

Our study has several limitations. It is an analysis of a relatively small group of children with overall a low percentage of CT rates. In a bigger cohort it would have been possible to extract more objective factors favouring a CT scan. Secondly, we did not ask clinicians their argument for their choice. Therefore, we can only describe objective factors that suggest a CT scan in an IR group of young children with MTHI, which could potentially influence clinicians’ choice. However, specific individual reasons remain unknown.

Conclusion:

Our study demonstrates that clinicians prefer clinical observation above performing a CT scan in young children with MTHI in an IR group. In addition, we found three factors which could contribute to this decision. However, since there is no rational for these factors caution is advised to incorporate them in current guidelines. In order to optimise current national guidelines shared decision making could be introduced.

226 **References**

- 227 1. Kuppermann N, Holmes JF, Dayan PS, et al (2009) Identification of children at very
228 low risk of clinically-important brain injuries after head trauma: a prospective cohort
229 study. *Lancet* 374:1160–1170. [https://doi.org/10.1016/S0140-6736\(09\)61558-0](https://doi.org/10.1016/S0140-6736(09)61558-0)
- 230 2. Dunning J, Daly JP, Lomas J-P, et al (2006) Derivation of the children's head injury
231 algorithm for the prediction of important clinical events decision rule for head injury in
232 children. *Arch Dis Child* 91:885–891. <https://doi.org/10.1136/adc.2005.083980>
- 233 3. Osmond MH, Klassen TP, Wells GA, et al (2010) CATCH: A clinical decision rule for
234 the use of computed tomography in children with minor head injury. *CMAJ* 182:341–
235 348. <https://doi.org/10.1503/cmaj.091421>
- 236 4. Hageman G, Pols MA, Schipper DM, et al (2010) Richtlijn Opvang Van Patiënten Met
237 Licht Traumatisch Hoofd / Hersenletsel. Utrecht: Nederlandse Vereniging Neurologie.
238 [https://richtlijndatabase.nl/richtlijn/licht_traumatisch_hoofd_hersenletsel_lth/licht_tr](https://richtlijndatabase.nl/richtlijn/licht_traumatisch_hoofd_hersenletsel_lth/licht_traumatisch_hoofd_hersenletsel_-_startpagina.html)
239 [aumatisch_hoofd_hersenletsel_-_startpagina.html](https://richtlijndatabase.nl/richtlijn/licht_traumatisch_hoofd_hersenletsel_lth/licht_traumatisch_hoofd_hersenletsel_-_startpagina.html)
- 240 5. Nigrovic LE, Kuppermann N (2019) Children With Minor Blunt Head Trauma
241 Presenting to the Emergency Department. *Pediatrics* 144(6):e20191495.
242 <https://doi.org/10.1542/peds.2019-1495>
- 243 6. Nishijima DK, Yang Z, Urbich M, et al (2015) Cost-effectiveness of the PECARN
244 rules in children with minor head trauma. *Ann Emerg Med* 65:72–80.
245 <https://doi.org/10.1016/j.annemergmed.2014.08.019>
- 246 7. Niele N, Willemars L, van Houten M, Plötz FB (2018) National survey on managing
247 minor childhood traumatic head injuries in the Netherlands shows low guideline
248 adherence and large interhospital variations. *Acta Paediatr* 107:168–169.
249 <https://doi.org/10.1111/apa.14076>
- 250 8. Ishida Y, Manabe A, Oizumi A, et al (2013) Association between parental preference

and head computed tomography in children with minor blunt head trauma. *JAMA*
Pediatr 167:491–492

9. Niele N, Willemars L, van Houten M, Plötz FB (2019) Large Variety of Medical Specialties Involved in Management of Pediatric Minor Traumatic Head Injury in the Netherlands. *Glob Pediatr Heal* 6:2333794X1984611. <https://doi.org/10.1177/2333794x19846117>
10. Niele N, van Houten MA, Boersma B, et al (2019) Multi-centre study found that strict adherence to guidelines led to computed tomography scans being overused in children with minor head injuries. *Acta Paediatr* 108:1695–1703. <https://doi.org/10.1111/apa.14742>
11. National Council on Radiation Protection and Measurements (2009). Ionizing radiation exposure of the population of the United States. Bethesda, MD: NCRP; Report No. 160. <https://ncrponline.org/publications/reports/ncrp-report-160-2>
12. Sheppard JP, Nguyen T, Alkhalid Y, et al (2018) Risk of Brain Tumor Induction from Pediatric Head CT Procedures: A Systematic Literature Review. *Brain Tumor Res Treat* 6:1. <https://doi.org/10.14791/btrt.2018.6.e4>
13. Reedijk AMJ, van der Heiden-van der Loo M, Visser O, et al (2017) Site of childhood cancer care in the Netherlands. *Eur J Cancer* 87:38–46. <https://doi.org/10.1016/j.ejca.2017.09.030>
14. Meulepas JM, Ronckers CM, Smets AMJB, et al (2019) Radiation exposure from pediatric CT scans and subsequent cancer risk in the Netherlands. *J Natl Cancer Inst* 111:256–263. <https://doi.org/10.1093/jnci/djy104>
15. The management of minor closed head injury in children (1999). Committee on Quality Improvement, American Academy of Pediatrics. Commission on Clinical Policies and

275 Research, American Academy of Family Physicians. *Pediatrics* Dec;104(6):1407-15.
 276 PMID: 10585999.

277 16. Schutzman SA, Barnes PD, Mantello M, Scott RM (1993) Epidural hematomas in
 278 children. *Ann Emerg Med* 22:535–541. [https://doi.org/10.1016/s0196-0644\(05\)81938-](https://doi.org/10.1016/s0196-0644(05)81938-9)
 279 9

280 17. Hamilton M, Mrazik M, Johnson DW (2010) Incidence of delayed intracranial
 281 hemorrhage in children after uncomplicated minor head injuries. *Pediatrics* 126:e33-
 282 39. <https://doi.org/10.1542/peds.2009-0692>

283 18. Natale JAE, Joseph JG, Rogers AJ, et al (2012) Cranial computed tomography use
 284 among children with minor blunt head trauma: Association with race/ethnicity. *Arch*
 285 *Pediatr Adolesc Med* 166:732–737. <https://doi.org/10.1001/archpediatrics.2012.307>

286 19. Foks KA, Dijkland SA, Lingsma HF, et al (2019) Risk of intracranial complications in
 287 minor head injury: The role of loss of consciousness and post-traumatic amnesia in a
 288 multi-center observational study. *J Neurotrauma* 36:2377–2384.
 289 <https://doi.org/10.1089/neu.2018.6354>

290 20. Lee LK, Monroe D, Bachman MC, et al (2014) Isolated loss of consciousness in
 291 children with minor blunt head trauma. *JAMA Pediatr* 168:837–843.
 292 <https://doi.org/10.1001/jamapediatrics.2014.361>

293 21. Schneider EB, Hirani SA, Hambridge HL, et al (2012) Beating the weekend trend:
 294 increased mortality in older adult traumatic brain injury (TBI) patients admitted on
 295 weekends. *J Surg Res* 177:295–300. <https://doi.org/10.1016/j.jss.2012.06.022>

296 22. Niele N, van Houten M, Tromp E, et al (2020) Application of PECARN rules would
 297 significantly decrease CT rates in a Dutch cohort of children with minor traumatic head
 298 injuries. *Eur J Pediatr* 179:1597–1602. <https://doi.org/10.1007/s00431-020-03649-w>

299 23. Ishida Y, Manabe A, Oizumi A, et al (2013) Association between parental preference

300 and head computed tomography in children with minor blunt head trauma. JAMA
301 Pediatr 167:491–492. <https://doi.org/10.1001/jamapediatrics.2013.1448>
302 24. Hess EP, Homme JL, Kharbanda AB, et al (2018) Effect of the Head Computed
303 Tomography Choice Decision Aid in Parents of Children With Minor Head Trauma: A
304 Cluster Randomized Trial. JAMA Netw open 1:e182430–e182430.
305 <https://doi.org/10.1001/jamanetworkopen.2018.2430>
306

Table 1. Management of children under 6 years of age with MTHI classified as intermediate risk (IR) (N = 280)

Children < 6 years of age in an IR group with choice between observation and CT scan (N = 280)							
		Total N = 280 (%)	Isolated CT scan N = 15 (%)	Observation N = 228 (%)	CT and observation N = 6 (%)	Discharge N = 31 (%)	Significance
Gender	male	157 (56.1)	11 (7.0)	129 (82.2)	3 (1.9)	14 (8.9)	p=0.332
	female	123 (43.9)	4 (3.3)	99 (80.5)	3 (2.4)	17 (13.8)	
Age	<1 y	101 (36.1)	0 (0)	93 (92.1)	2 (2.0)	6 (5.9)	p<0.001
	1-2 y	83 (29.6)	1 (1.2)	67 (80.7)	3 (3.6)	12 (14.5)	
	2-3 y	37 (13.2)	4 (10.8)	27 (73.0)	0 (0)	6 (16.2)	
	3-4 y	25 (8.9)	5 (20.0)	18 (72.0)	0 (0)	2 (8.0)	
	4-5 y [§]	34 (12.1)	5 (14.7)	23 (67.6)	1 (2.9)	5 (14.7)	
Primary responsible specialism	Paediatrician	146 (52.1)	12 (8.2)	113 (77.4)	3 (2.1)	18 (12.3)	p=0.632
	Neurologist	22 (7.9)	0 (0)	21 (95.5)	0 (0)	1 (4.5)	
	Surgeon	48 (17.1)	1 (2.1)	41 (85.4)	2 (4.2)	4 (8.3)	
	Emergency physician	63 (22.5)	2 (3.2)	52 (82.5)	1 (1.6)	8 (12.7)	
	Other	1 (0.4)	0 (0)	1	0 (0)	0 (0)	
Day of presentation	Weekday	189 (67.5)	7 (3.7)	162 (85.7)	5 (2.6)	15 (7.9)	p=0.018
	Weekend day [#]	91 (32.5)	8 (8.8)	66 (72.5)	1 (1.1)	16 (17.6)	
Time of injury*	08.00-17.00	152 (58.7)	12 (7.9)	119 (78.3)	4 (2.6)	17 (11.2)	p=0.352
	17.00-08.00	107 (41.3)	3 (2.8)	88 (82.2)	2 (1.9)	14 (13.1)	
Time of presentation	08.00-17.00	132 (47.3)	9 (6.8)	105 (79.5)	4 (3.0)	14 (10.6)	p=0.568
	17.00-08.00	147 (52.7)	6 (4.1)	122 (83.0)	2 (1.4)	17 (11.6)	
Trauma mechanism	Fall ≤ 1 meter	130 (47.1)	6 (4.6)	104 (80.0)	1 (0.8)	19 (14.6)	p=0.227
	Fall >1 meter	146 (52.9)	9 (6.2)	121 (82.9)	4 (2.7)	12 (8.2)	
	Pedestrian/bicyclist vs motor vehicle	3 (1.1)	0 (0)	2 (66.7)	0 (0)	1 (33.3)	p=0.646
	No pedestrian/bicyclist vs motor vehicle	277 (98.9)	15 (5.4)	226 (81.6)	6 (2.2)	30 (10.8)	
	Discharge from motor vehicle	0					1
	No discharge from motor vehicle	280 (100)	15 (5.4)	228 (81.4)	6 (2.1)	31 (11.1)	

	Other	29 (10.4)	3 (10.3)	20 (69.0)	0 (0)	6 (20.7)	p=0.139
	No other	251 (89.6)	12 (4.8)	208 (82.9)	6 (2.4)	25 (10.0)	
Any loss of consciousness*	Yes	31 (11.1)	5 (16.1)	24 (77.4)	1 (3.2)	1 (3.2)	p=0.022
	No	248 (88.9)	10 (4.0)	203 (81.9)	5 (2.0)	30 (12.1)	

§ Children aged both 4 and 5 years old; # Defined as Saturday and Sunday and all Dutch feast days; * Some missing data.