Tampereen yliopisto

Mikko Nurmi

LASTEN LIIKENNEONNETTOMUUDET – AJANKOHTAISET EPIDEMIOLOGISET TRENDIT SUOMALAISESSA YLIOPISTOSAIRAALASSA

Lääketieteen ja terveysteknologian tiedekunta
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TIIVISTELMÄ

Mikko Nurmi
Paediatric Traffic Accidents – Current Epidemiological Trends at a Finnish University Hospital
(Lasten liikenneonnettomuudet – Ajankohtaiset epidemiologiset trendit suomalaisessa yliopistosairaalassa)
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Lasten liikennetapaturmat (LTT:t) ovat maailmanlaajuisesti yksi merkittävimmistä syistä nuorison vammautumisille ja kuolemille. Ajankohtaisimman tutkimustiedon mukaan kuolemiin johtavat lasten LTT:t ovat viime vuosina vähentyneet korkean tulotason maissa, mutta toisaalta tutkimustieto muiden kuin kuolemaan johtaneiden LTT:ien osalta on vähäistä ja vanhentunutta. Siispä tutkimuksemme tavoitteena on raportoida Tampereella Suomessa ensiapuun joutuneiden lasten ja nuorten LTT:ien epidemiologiaa ja selvittää ajankohtaisia trendejä.

Toteutimme retrospektiivisen kohorttitutkimuksen Tampereen yliopistollisessa sairaalassa 1.1.2016 ja 31.7.2017 välisenä aikana. Tutkittu ihmisryhmä koostui kaikista 16-vuotiaista tai nuoremmista LTT:aan joutuneista traumapotilaista. Kokonaisuudessaan 386 tapausta (386 käyntiä / 381 potilasta) täyttivät sisäänottokriteerit. Käynneistä raportoitiin muuttujia kuten käynnin pituus, eri onnettomuustyyppien ja vammatyyppien ilmaantuvuudet sekä ajallinen vaihtelu.

Potilaiden keski-ikä oli 12,2 ± 4,2 -vuotta, heistä suurin osa oli poikia (n = 247, 64 %). Tutkimusjaksolla lasten LTT:ien ilmaantuvuus Tampereella oli 26,6 tapausta 10 000 asukasta kohden. Korkein ilmaantuvuus (119,6) oli 15-vuotiailla. Suurin osa LTT:ista tapahtui kesällä. 33 % (n = 127) potilaista ei tarvinnut lainkaan hoitoa ja vain 16 % (n = 62) sairaalakäynneistä kesti kaksi yötä tai enemmän. Mopo/moottoripyörä oli yleisin onnettomuuteen johtava kulkuneuvo, aiheuttaen 35 % (n =134) kaikista onnettomuuksista johtaen myös vakavimpiin vammoihin. Yleisin vammatyyppi oli pinnallinen vamma (n = 142, 38 %) ja vammojen yleisin anatominen sijainti oli alaraajat (n = 130, 34 %).

Tutkimuksen perusteella voimme päätellä, että suurin osa lasten liikennetapaturmista Tampereella on lieviä ja niistä seuranneet vammat vaativat vain kevyttä hoitoa. Huolimatta tästä riski joutua liikenneonnettomuuteen lisääntyy rajusti, kun lapsi tulee ikään, jolloin hänen on mahdollista saada mopokortti. Tutkimuksessa kuvatut löydökset korostavat paremmin kohdistetun lasten LTT:ien ehkäisyn tarvetta.

Avainsanat: Tieliikenneonnettomuudet, Lapset, Epidemiologia, Liikennetapaturmat

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Paediatric traffic accidents – current epidemiological trends at a finnish university hospital

Mikko Nurmi, BM[a,*], Sally Järvelä, PhD[b], Ville M. Mattila, PhD[a,c,d], Teemu M. Luoto, PhD[e], Satu-Liisa Pauniaho, PhD[b,f]

[a] Faculty of Medicine and Health Technology, Tampere University, Tampere, Finland
[b] Emergency Division of Pirkanmaa Hospital District, Tampere University Hospital and Tampere University, Tampere, Finland
[c] Division of Orthopaedics and Traumatology, Department of Trauma, Musculoskeletal Surgery and Rehabilitation, Tampere University Hospital, Tampere, Finland
[d] Coxa Joint Replacement Hospital, Tampere, Finland
[e] Department of Neurosurgery, Tampere University Hospital and Tampere University, Tampere, Finland
[f] Department of Adolescent Psychiatry, Tampere University Hospital, Tampere, Finland

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ABSTRACT

Background: Paediatric traffic accidents (TA) have a major impact globally on youth deaths and disabilities. It is known that the trends of TAs leading to fatal outcomes are decreasing in high-income countries. However, the literature concerning children's non-fatal TAs is scarce and outdated. The aim of this study was to report on the epidemiology of TAs amongst children admitted to the emergency department (ED) in Tampere, Finland.

Materials and methods: We conducted a descriptive retrospective cohort study in Tampere University Hospital from January 2016 to May 2017. The study population consisted of all TA trauma patients aged 16 years or younger. A total of 386 cases (386 visits / 381 patients) fulfilled the inclusion criteria. Outcome variables such as length of stay, incidences of different accidents and types injuries, and seasonal variation were recorded.

Results: The mean age of the patients was 12.2 ± 4.2 years (boys: n = 247, 64%). The incidence of TAs in Tampere was 26.6 per 10,000 with a peak of 119.6 in children 15 years of age. Most of the TAs occurred during the summer. Of the patients admitted to the ED, 33% (n = 127) did not require any specific medical treatment, and only 16% (n = 62) of the hospital stays lasted for two nights or more. Mopeds/motorcycles were the vehicles most commonly involved in accidents causing 35% (n = 134) of all accidents and resulting in the most severe injuries. The most common injuries were superficial (n = 142, 38%) and the most frequent anatomical region affected was the lower limbs (n = 130, 34%).

Conclusion: We found that the majority of childhood traffic accidents in Tampere were mild and required only minor treatment. However, when the child reaches the legal age for acquiring a driving licence for a moped the risk for TAs and resulting injuries increases dramatically. These findings highlight the need for better targeted TA prevention.

Introduction

Paediatric traffic accidents (TAs) are an important public health concern due to their high global impact on youth deaths and disabilities [1]. According to the World Health Organization, road traffic accidents (RTAs) are the leading cause of death amongst 15–19-year-olds and the second leading cause amongst 5–14-year-olds [2,3]. In addition to mortality, several studies have highlighted TAs as one of the most common and severe causes of childhood injuries [4–9]. Although TA mortality has been decreasing in high-income countries such as Finland, TAs account for over seven per cent of disability-adjusted life years (DALYs) in 15–19-year-olds and close to three per cent in younger children, being also the main

* Corresponding author.
E-mail addresses: mikko.nurmi@tuni.fi (M. Nurmi), sally.jarvela@pshp.fi (S. Järvelä), ville.mattila@tuni.fi (V.M. Mattila), teemu.luoto@pshp.fi (T.M. Luoto), satu-liisa.pauniaho@pshp.fi (S.-L. Pauniaho).

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cause of injury-related death [5,10–12]. Apart from the burden of substantial mental, physical and cognitive disabilities, TAs result in major socioeconomic costs [3,5,13–16].

The annual TA fatality rate in Finland decreased by half, from 100 to 50, amongst 15–24 year-olds during the last decade [17]. In the same period, the number of non-fatal TA injuries decreased by a third [17]. amongst children aged 0–14, the decline in fatal TAs has likewise been dramatic: from 149 in 1971 to seven in 2010, although for the last 15 years the decline has slowed down [7,18]. The downward trend in fatal TA injuries has persisted for the last 60 years, even though the number of vehicles has increased, but at the same time overall morbidity has not changed as significantly [18–20]. The decrease in injuries and fatalities originates from several amendments to the Finnish legislation and changes in the automotive industry and patient care, and the same can be seen in other high-income countries [10,20]. Despite these efforts, Finland is only in the twelfth place in the ranking of the safest countries in Europe regarding road safety, thus further actions are warranted [21].

Earlier epidemiological studies on TAs have been predominantly conducted in low- and middle-income countries with an emphasis on adults and fatal injuries. The scientific literature concerning children's non-fatal TAs is scarce and outdated. There is a clear need to create applicable solutions for better injury prevention [2,3,10,20]. Although the trends of TAs leading to fatal outcomes are well known, there are no subsequent studies addressing the non-fatal injuries caused by TAs in high-income countries.

The purpose of this study was to provide a detailed examination of children ($\leq$ 16 years) in a high-income country admitted to an emergency department (ED) after TA. A special interest was to identify potential targets for future preventive measures for children's TAs. We hypothesized that major injuries would be rare and related mostly to motor vehicles as paediatric mortality in Finland is low, but mostly related to motor vehicles [18]. We also expected boys to be overrepresented in the study sample based on previous studies [4,6,14,16,18].

Materials and methods

This descriptive retrospective cohort study focused on trauma patients aged 16 years or younger admitted to the ED of the Tampere University Hospital, Tampere, Finland due to a traffic accident between the 1st of January 2016 and the 31st of May 2017. The study protocol was approved by the Tampere University Hospital's administration (approval number: R175695). Due to the retrospective nature of study, no formal ethical approval was acquired. The Tampere University Hospital's ED has around 100,000 yearly visits (20% traumas of which 17% concern patients 0–16 yrs.). The ED is the main public referral centre for paediatric injuries and is responsible for more than 95,000 children aged 0 to 16 living in the Pirkanmaa Health Care District [22,23]. Pirkanmaa covers both rural and urban areas.

All ED-admitted TA patients with an ICD-10 external cause code of V00-V99 were identified from the hospital electronic medical records. Additionally, the medical records were electronically searched with the terms "traffic accidents" and "road traffic accidents" indicating a traffic accident not covered by the ICD-10 external cause coding. The patients initially included were thereafter verified manually as TA patients by reviewing the medical records. A TA was defined as follows: i) an accident which took place on a road and involved at least one moving vehicle, or ii) an off-road accident involving at least one moving vehicle. Any injury without the involvement of a moving vehicle was excluded from the study. Along with the initial ED record screening, we identified from the electronic medical records all patients admitted to the paediatric surgical ward. A total of 952 cases were found, 78 of which were duplicates (Fig. 1). Data collection included demographic, injury- and treatment-related details. Accident types were classified by the vehicle the child was in at the moment of the accident, injury types were classified by the anatomical region affected as well as the type of the injury. TA incidences were reported in terms of 1:10,000. For the statistical analyses, the patients were stratified into the following age groups: i) preschool

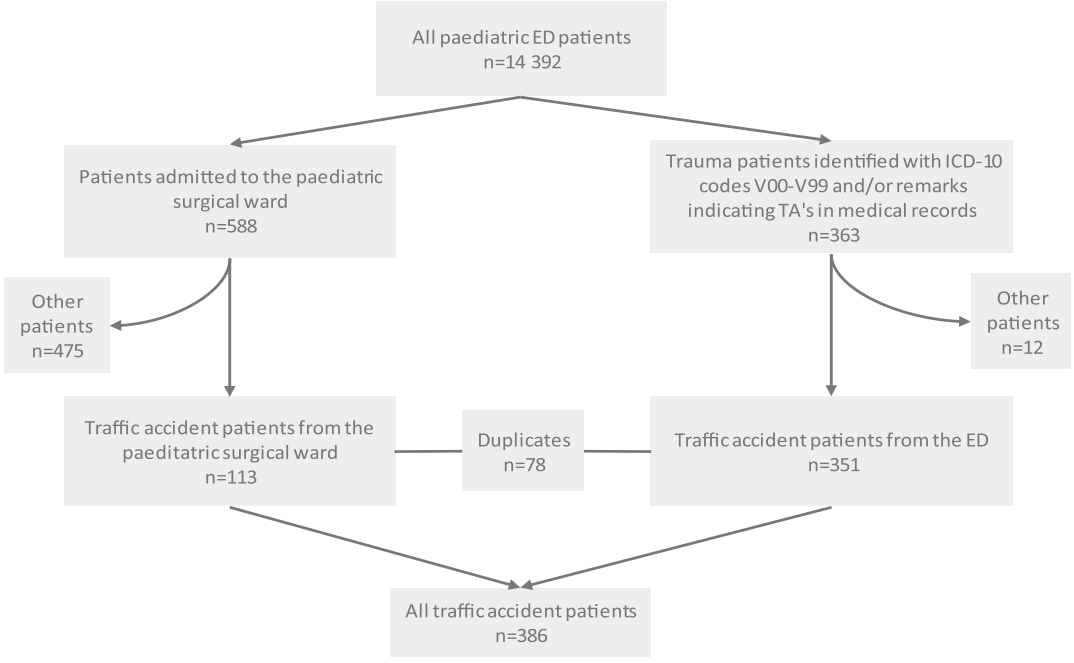

Fig. 1. Flow chart of the selection of the study population for 0–16-year-old traffic accident patients attending the emergency department of Tampere University Hospital (January 2016 - May 2017).

(0–6 years), ii) children before (7–14 years), and iii) after (15–16 years) the legal age for driving a moped. The statistical analyses were performed using IBM SPSS Statistics software version 25 (Armonk, New York, USA). The statistical analysis included the X^2 test for categorical data and proportions, one-way ANOVA test for differences of means and Wilson score interval for confidence intervals of 95%. The level of statistical significance was set at 5%.

Results

Altogether 386 cases (386 visits / 381 patients) met the inclusion criteria (Table 1). The mean age of the patients was 12.2 ± 4.2 years (Range 0–16.99 years), and age and gender distributions are presented in Fig. 2 and Table 1. Of the 386 injuries, only one was fatal (0.3%). The fatality was due to a subarachnoid haemorrhage and diffuse brain damage caused by a car accident where the patient had himself been driving. The incidences were calculated only for Tampere residents (146 TAs) due to the possibility of residents of rural Pirkanmaa area being treated outside the Tampere University Hospital.

The incidence of TAs in Tampere city was 27.8 per 10,000 per year (boys 30.4 and girls 25.2). The age group stratified incidences were as follows: age 0–6 years = 13.0, 95% CI = 8.49–20.0; age 7–14 = 29.9, 95% CI = 21.9–39.9; and age 15–16 = 82.0, 95% CI = 57.7–116. A clear peak in incidence was seen amongst 15-year-olds (incidence = 119.6).

Table 1
Distribution of number and percentage of genders, earlier accidents, accident types and injury types between age groups for 0–16-year-old traffic accident patients attending the emergency department of Tampere University Hospital (January 2016 - May 2017).

	Age groups			
	0-6 yo N %	7-14 yo N %	15-16 yo N %	Total N %
Gender				
Male	32 46.4	113 72.0	102 63.8	247 64.0
Female	37 53.6	44 28.0	58 36.3	139 36.0
Total	69 100.0	157 100.0	160 100.0	386 100.0
Earlier accidents				
0	48 69.6	95 60.5	91 56.9	234 60.6
1	16 23.2	37 23.6	42 26.3	95 24.6
2 or more	5 7.2	25 15.9	27 16.9	57 14.8
Total	69 100.0	157 100.0	160 100.0	386 100.0
Accident type				
Moped/Motorcycle	3 4.3	25 15.9	106 66.3	134 34.7
Bicycle	31 44.9	80 51.0	8 5.0	119 30.8
Car passenger	16 23.2	17 10.8	11 6.9	44 11.4
Other	14 20.3	17 10.8	3 1.9	34 8.8
Quadricycle	0 0.0	5 3.2	19 11.9	24 6.2
Pedestrian	3 4.3	11 7.0	7 4.4	21 5.4
All-terrain vehicle	2 2.9	2 1.3	6 3.8	10 2.6
Total	69 100.0	157 100.0	160 100.0	386 100.0
Injuries				
Anatomical region				
Lower limb	19 27.5	55 35.0	56 35.0	130 33.7
Upper limb	24 34.8	57 36.3	45 28.1	126 32.6
Head	22 31.9	34 21.7	39 24.4	95 24.6
Torso	5 7.2	17 10.8	21 13.1	43 11.1
Neck	4 5.8	14 8.9	9 5.6	27 7.0
Injury type				
Superficial injury	22 31.9	58 36.9	62 38.8	142 36.8
Fracture	24 34.8	57 36.3	54 33.8	135 35.0
Multiple injuries	11 15.9	26 16.6	29 18.1	66 17.1
Brain	16 23.2	25 15.9	23 14.4	64 16.6
Dislocation/sprain/rupture	8 11.6	22 14.0	18 11.3	48 12.4
No injuries	6 8.7	11 7.0	8 5.0	25 6.5
Other	0 0.0	8 5.1	14 8.8	22 5.7
Internal organ	2 2.9	6 3.8	6 3.8	14 3.6
Total number of injuries	72 104.3	176 112.1	177 110.6	425 110.1
Total	69 100.0	157 100.0	160 100.0	386 100.0

yo=years old

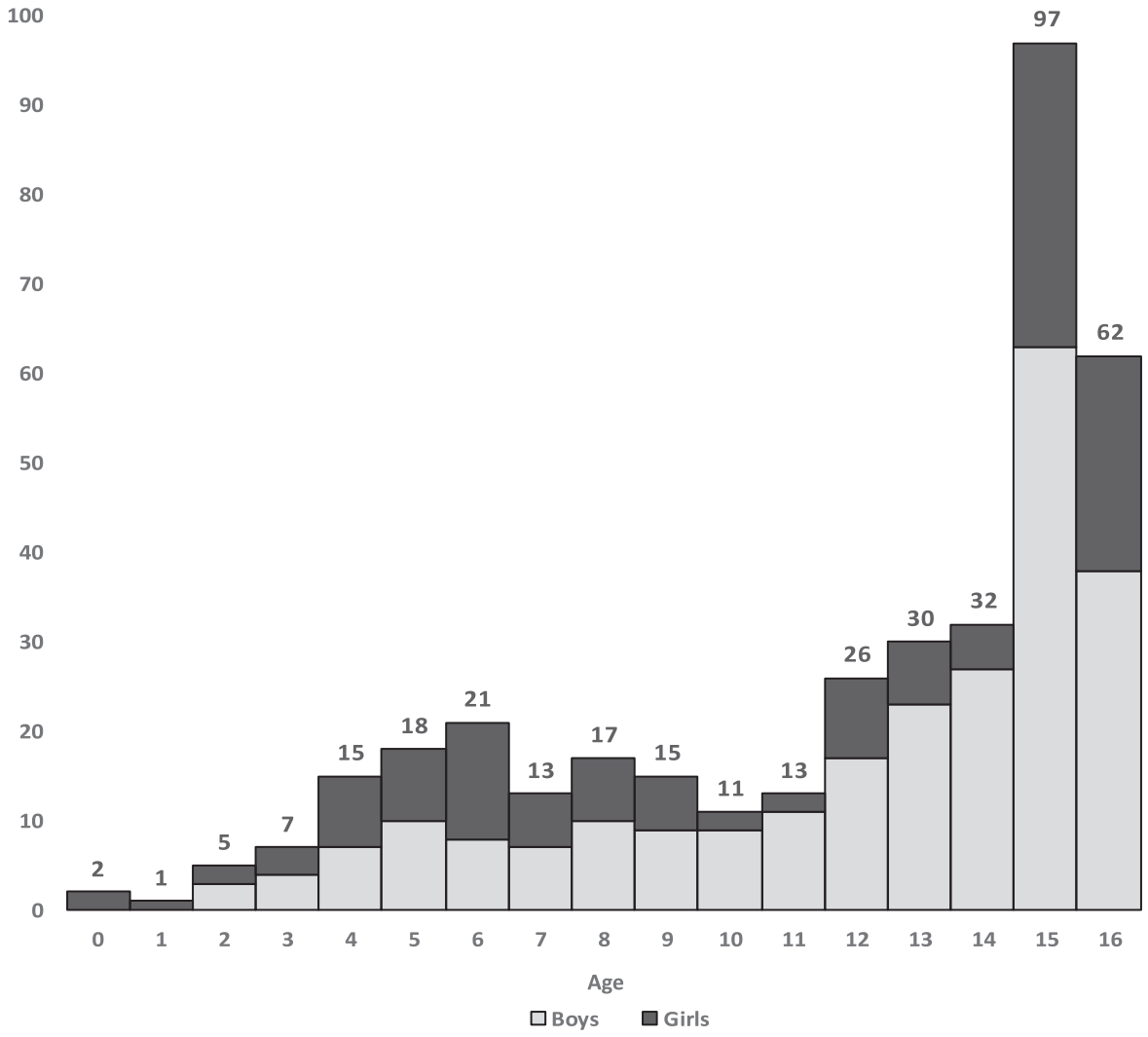

Fig. 2. Histogram of the age and gender distribution of the study population for 0–16-year-old traffic accident patients attending the emergency department of Tampere University Hospital (January 2016 - May 2017).

Types of accidents

The main finding was that one third of the injuries were caused by moped/motorcycle accidents (of which 92% concerned drivers and 8% passengers). The severity of injuries caused by each accident type was estimated by number of injuries, need for intensive care unit (ICU) treatment, and length of hospital stay. Using these measures moped/motorcycle, pedestrian and all-terrain vehicle (ATV) accidents were the most severe ones (Table 2).

Seasonal variation

Seasonal variation was apparent in the distribution of TAs over the year. More TAs occurred in the summer months (mean daytime temperature +10°C May to September): the mean incidence was 41 TAs per month. In the winter months (mean daytime temperature less than −10°C; November to March), the mean incidence was only 9.4 TAs per month [24]. Most of the TAs occurred in the afternoon and evening (15:00–21:00; 53%). In addition, the TAs occurred mostly during time away from home, school, daycare or hobbies (83.1%).

Treatment

A large number of patients did not suffer any major injuries (Table 3). A third of the patients (33%, $n = 127$) did not need any medical treatment in the ED, and only 16% ($n = 62$) of the hospital stays lasted two nights or more, the longest stay being 31 days. Regarding operative treatment, surgery was performed on 20.3% ($n = 79$) of the patients and most frequently concerned the upper limbs (46%, $n = 44$ operations, five of which were closed reductions), or the lower limbs (36%, $n = 35$ operations, eight of which were closed reductions). Boys were more likely to require treatment (procedures other than imaging or short-term (less than 24 h) follow-up) than girls (boys 73.5%, girls 54.7%; $P < 0.001$) and the same was seen in relation to surgery (boys 25.1%, girls 12.2% $P = 0.003$). Three cases were excluded from treatment analyses as the patient left the hospital before the need for treatment or imaging could be evaluated.

Age groups and gender

We found a considerable variation in gender distribution in relation to accident types. Girls were more prone than boys to be

Table 2
Number, percentage, incidence and confidence intervals of different injuries for each accident type concerning 0–16-year-old traffic accident patients attending the emergency department of Tampere University Hospital (January 2016 - May 2017).

	Accident type																							
	Moped/Motorcycle N total = 134				Bicycle N total = 119				Car passenger N total = 44				Other N total = 34				Quadricycle N total = 24				Pedestrian N total = 21				All-terrain vehicle N total = 10			
	N	%[a.]	IN[b.]	CI[c.]	N	%[a.]	IN[b.]	CI[c.]	N	%[a.]	IN[b.]	CI[c.]	N	%[a.]	IN[b.]	CI[c.]	N	%[a.]	IN[b.]	CI[c.]	N	%[a.]	IN[b.]	CI[c.]	N	%[a.]	IN[b.]	CI[c.]
Injuries																								
Anatomical region																								
Lower limb	50	38.5	0.37	±.08	39	30.0	0.33	±.08	12	9.2	0.27	±.11	12	9.2	0.35	±.14	6	4.6	0.25	±.13	8	6.2	0.38	±.17	3	2.3	0.30	±.19
Upper limb	31	26.1	0.23	±.06	47	39.5	0.39	±.08	19	16.0	0.43	±.14	2	1.7	0.06	±.04	10	8.4	0.42	±.17	6	5.0	0.29	±.15	4	3.4	0.40	±.23
Head	38	40.0	0.28	±.07	29	30.5	0.24	±.07	10	10.5	0.23	±.10	6	6.3	0.18	±.09	5	5.3	0.21	±.12	4	4.2	0.19	±.11	3	3.2	0.30	±.19
Torso	20	46.5	0.15	±.05	11	25.6	0.09	±.04	2	4.7	0.05	±.03	5	11.6	0.15	±.08	3	7.0	0.13	±.08	1	2.3	0.05	±.04	1	2.3	0.10	±.08
Neck	8	29.6	0.06	±.03	12	44.4	0.10	±.04	1	3.7	0.02	±.02	2	7.4	0.06	±.04	2	7.4	0.08	±.06	2	7.4	0.10	±.07	0	0.0	0.00	±.00
Injury type																								
Superficial injury	57	40.1	0.43	±.08	43	30.3	0.36	±.08	13	9.2	0.30	±.11	9	6.3	0.26	±.12	7	4.9	0.29	±.14	9	6.3	0.43	±.18	4	2.8	0.40	±.23
Fracture	38	28.1	0.28	±.07	43	31.9	0.36	±.08	19	14.1	0.43	±.14	12	8.9	0.35	±.14	12	8.9	0.50	±.19	8	5.9	0.38	±.17	3	2.2	0.30	±.19
Multiple injuries	27	40.9	0.20	±.06	25	37.9	0.21	±.06	3	4.5	0.07	±.04	3	4.5	0.09	±.06	2	3.0	0.08	±.06	4	6.1	0.19	±.11	2	3.0	0.20	±.14
Brain	26	40.6	0.19	±.06	23	35.9	0.19	±.06	7	10.9	0.16	±.08	4	6.3	0.12	±.07	1	1.6	0.04	±.03	1	1.6	0.05	±.04	2	3.1	0.20	±.14
Dislocation/sprain/rupture	15	31.3	0.11	±.04	17	35.4	0.14	±.05	2	4.2	0.05	±.03	7	14.6	0.21	±.10	3	6.3	0.13	±.08	4	8.3	0.19	±.11	0	0.0	0.00	±.00
No injuries	7	28.0	0.05	±.03	6	24.0	0.05	±.03	8	32.0	0.18	±.09	2	8.0	0.06	±.04	2	8.0	0.08	±.06	0	0.0	0.00	±.00	0	0.0	0.00	±.00
Other	10	45.5	0.07	±.03	6	27.3	0.05	±.03	3	13.6	0.07	±.04	0	0.0	0.00	±.00	1	4.5	0.04	±.03	2	9.1	0.10	±.07	0	0.0	0.00	±.00
Internal organ	7	50.0	0.05	±.03	3	21.4	0.03	±.02	0	0.0	0.00	±.00	2	14.3	0.06	±.04	2	14.3	0.08	±.06	0	0.0	0.00	±.00	0	0.0	0.00	±.00
Total number of injuries	153	36.0	1.14		135	31.8	1.13		44	10.4	1.00		34	8.0	1.00		26	6.1	1.08		24	5.6	1.14		9	2.1	0.90	
Hospital stay descriptives																								
Number of ICU visits	9	39.1	0.07	±.03	7	30.4	0.06	±.03	2	8.7	0.05	±.03	0	0.0	0.00	±.00	0	0.0	0.00	±.00	3	13.0	0.14	±.09	2	8.7	0.20	±.14
Length of stay in nights	160	41.5	1.19		80	20.7	0.67		15	3.9	0.34		29	7.5	0.85		4	1.0	0.17		56	14.5	2.67		20	5.2	2.00	

[a.] Row per cent

[b.] Incidence per accident type

[c.] Confidence interval

Table 3
Distribution and mean of length of stay (measured in nights) and number of patients (0–16 years old) admitted to the ED, surgical ward or ICU, as well as the number and percentage of imaging and operations. Tampere University Hospital (January 2016 - May 2017).

	Age groups			
	0-6 yo	7-14 yo	15-16 yo	Total
	N Mean	N Mean	N Mean	N Mean
Stay descriptives				
Emergency department	69 1.00	157 1.00	160 1.00	386 1.00
Surgical ward	20 0.29	56 0.36	44 0.28	
*Length of stay**	35 1.75	140 2.50	101 2.30	196 1.72
ICU	3 0.04	11 0.07	9 0.06	
*Length of stay**	14 4.67	48 4.36	11 1.22	152 7.60
Total length of stay*	49 0.72	192 1.23	123 0.77	364 0.95
	N %	N %	N %	N %
Images taken during hospitalization				
RTG				
None	40 58.0	57 36.3	63 39.6	160 41.6
1	11 15.9	46 29.3	41 25.8	98 25.5
2 or more	18 26.1	54 34.4	55 34.6	127 33.0
Total RTG count	60	200	206	466
CT				
None	64 92.8	125 79.6	111 69.8	300 77.9
1	4 5.8	20 12.7	39 24.5	63 16.4
2 or more	1 1.4	12 7.6	9 5.7	22 5.7
Total CT count	6	53	59	118
MRI				
None	68 98.6	147 93.6	151 95.0	366 95.1
1	0 0.0	7 4.5	7 4.4	14 3.6
2 or more	1 1.4	3 1.9	2 1.3	6 1.6
Total MRI count	2	14	11	27
Total images count	68	267	276	611
Operations during hospitalization				
None	59 85.5	116 73.9	132 83.0	307 79.7
1	10 14.5	36 22.9	21 13.2	67 17.4
2 or more	1 1.4	5 3.2	6 3.8	12 3.1
Total operations count	12	49	35	96

*Number of nights spent in hospital

in passive roles in accidents: as car passengers (girls: $n = 24$, incidence = 17.4; boys: $n = 20$, incidence = 8.1; $P = 0.006$), and as pedestrians (girls: $n = 13$, incidence = 9.4; boys: $n = 8$, incidence = 3.2; $P = 0.01$). Bicycle accidents caused more visits to the ED for girls (Bicycle: $n = 40$, incidence = 29.0; Motorcycle/moped: $n = 35$, incidence = 25.4), whereas motorcycle/moped accident was the most common cause for boys ($n = 98$, incidence = 39.7). The boys had significantly more lower limb fractures than the girls (17.8% versus 5.1%, $p = 0.0004$). There was no gender difference in the distribution of other types of injuries (all p-values > 0.05).

Discussion

The majority of childhood TAs in Pirkanmaa were mild, required little treatment and the injuries were mostly sustained to the limbs. In children under 15 years of age most of the accidents were caused by bicycles. However, after the age of 15, a significant change in incidence and accident type became apparent. amongst the 15- and 16-year-olds, moped/motorcycle-related accidents were the most common accident type. Most TAs happened during the summer months, most likely due to the more favourable weather conditions for bicycle and moped/motorcycle riding.

Most of the research so far has focused on TAs leading to fatalities or only on motorcycle or car accidents, thus differing from our study design. In the present study, we did not include traffic-related out-of-hospital deaths, only patients admitted to the ED. Again, most other research has only included children up to 15 years of age, which explains the smaller number of motorcycle/moped accidents in earlier studies. Despite the different focus of this study, it also has several findings which corroborate those of earlier studies. Seasonal variability is also apparent in other stud-

ies, although not as notably as in our study. This is probably due to the northern location of Finland and therefore the use of mopeds, motorcycles and bicycles is decidedly limited during the winter [6,16,17,25]. The gender distribution is commonly found to be skewed towards boys and injury distribution resulting from similar causes has likewise been previously recorded [4,6,14,16,25,26]. Furthermore, our incidence rates are in line with those of one Swedish study including children up to 12 years of age [26]. The greater number of bicycle accidents in our study compared to earlier reports may be due to the inclusion of milder injuries as most of the bicycle injuries were mild. The small number of accidents to car passengers observed in our study is possibly due to changes in the legislation and the automotive safety (e.g., speed limits, airbags, compulsory winter tires, carless city centres) [5,10,20,27].

The Tampere University Hospital is responsible for treating large numbers of people in rural and urban areas. This combined with the 1.5-year data collection period, large sample size, multifaceted search strategy to identify all patients of interest, carefully selected cases and well-managed patient records ensures that information bias was minimized. The results of the study are generalizable to the whole of Finland, and in some respects, to other high-income countries. Nonetheless, this study has some limitations. Firstly, it is known that not all ICD-10 codes are recorded correctly into the medical charts. To tackle this, we used open word search terms together with ICD-10 codes to detect as many cases as possible. Secondly, not all mild TA-related injuries in the catchment area are brought to the Tampere University Hospital. Some patients may have been treated by private practitioners and clinics. On the other hand, as we can safely assume that all serious injuries were treated in our hospital and registered correctly. This may have skewed the results so that the incidence of mild injuries was underestimated. Then again, our study sample did not include patients who died at the scene of the accident. Therefore the mortality observed most likely does not represent the true TA-related mortality. Overall Finnish road safety is slightly better than the EU average. Despite this, the percentage of young people (<17 years old) killed in moped accidents is the highest in Europe, which in turn has to be kept in mind when drawing generalizable conclusions from these results [25,28].

This study highlights the need for changes towards safer roads for children and moped and bicycle safety in particular should be targeted directly. However, further research is needed to determine the best prevention interventions.

Conclusions

Our results show that paediatric TAs are common, but fortunately serious consequences are rare. While knowledge of the causes leading to these injuries is limited, we can assume that one of the most important factors is the vehicles the child is driving. At the age of 15, children are vulnerable to TA-related injuries due to the increase in moped/motorcycle accidents. It is known that the trends of TAs leading to fatal outcomes are decreasing, but the literature on children's non-fatal TAs is scant and outdated. We hope that in the future children will be better taken into account in ongoing changes in the legislation and city planning to better prevent future TAs.

Declaration of Competing Interest

None.

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