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Driver's education may reduce annual incidence and severity of moped and scooter accidents. A population-based study

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ABSTRACT

Background and aims: In our previous study, the annual number of adolescents treated at Helsinki Children's Hospital and Töölö Trauma Centre for injuries from moped and scooter accidents increased five-fold between 2002 and 2007. In June 2011, the requirements for a moped/scooter license changed to include driver's education and a vehicle handling evaluation. The aim of this retrospective study was to assess the influence of legislative changes on moped and scooter related serious injuries in adolescents.
Patients and methods: Data from 520 patients (age 15–16) treated for trauma from moped and scooter accidents at our institutions between January 2008 and December 2013 were included. Case numbers were compared with population data from national databases. Overall incidence, trauma mechanism, injury profile, and proportion of patients requiring hospital admission were calculated for time periods before and after the law amendment.
Results: After the law change in 2011, the annual incidence of moped/scooter injuries among 15-year-olds in our area decreased from 0.8% in 2011 to 0.3% in 2013 ($p < 0.001$), and estimated incidence of injuries per new moped/scooter license declined from 1.8% in 2011 to 1.0% in 2013 ($p = 0.001$). Simultaneously, proportions of patients injured in collisions, diagnosed with multiple trauma or requiring in-patient care reduced.
Conclusions: A change in moped/scooter license requirements may have a causal relationship with both reduced number and severity of moped/scooter related injuries in adolescents.

Introduction

Two-wheeled motorised mopeds and scooters provide an easy means of transport both in urban and rural settings and have become highly popular among teens in Europe. Moped and scooter sales are increasing also in Australia, Canada, and the United States [1–3]. In Europe, road traffic injuries account for 20% of injury deaths among 0–18-year-olds [4], and half of these deaths are due to motorised two-wheelers [5]. In addition to mortality, moped and scooter riders face a 20–45-fold risk of injury in comparison to car drivers [1,6], and moped crash rates per distance travelled may also be nearly four-fold in comparison to motorcycles [7].

According to Finnish law, a 15-year old is allowed to drive a moped or scooter (maximum velocity of 45 km/h and maximum motor capacity of 50 cm^3). Until June 2011, a written permit from a legal guardian, a health certificate, and passing a written examination were required to obtain a moped or scooter driver's license. Between 2002 and 2007, the number of new moped/scooter licenses issued in Finland doubled, as did the proportion of 15–17-year old road traffic victims [8]. Our previous study covered the same time period in Finland's largest tertiary hospitals treating adolescents, and found a five-fold increase in annual patient numbers treated for trauma sustained in moped and scooter accidents [9]. In June 2011 the law was changed. Since then, moped/scooter driver's license applicants are required to participate in theoretical instruction and practical driving lessons (minimum six and three hours, respectively), followed by both a theoretical written exam and a vehicle handling test [10].

Minimum four hours of theoretical instruction must be on moped-related topics, and driving lessons must include at least an hour of vehicle handling and two hours of driving in traffic. The exam consists of ten verbal multiple choice questions including traffic signs (one false answer allowed) and 15 photographs of traffic situations with an attached true/false sentence (e.g. I am allowed to continue driving straight in this lane). The legal right to

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ride a moped or scooter with a pillion passenger remained unchanged, and helmets are required for both drivers and passengers.

Our aim was to evaluate the influence of the legislative change in reducing trauma from adolescents' moped and scooter accidents and to discuss further means of improving road traffic safety of adolescents.

Patients and methods

Patients

We gathered patient records of all children aged 7–16 years treated for trauma at the Helsinki Children's Hospital and Töölö Trauma Centre, Helsinki, Finland, or Jorvi Hospital, Espoo, Finland, between January 2008 and December 2013. For this study, inclusion criteria were: trauma from moped/scooter accidents (excluding motocross injuries), legal moped/scooter driving age (15 or 16 years) and living in the six cities or municipalities for which our centres serve as the primary source of specialist care (Helsinki, Espoo, Vantaa, Kirkkonummi, Kerava, and Kauniainen). Altogether 520 patients fulfilling inclusion criteria were identified and included in the study.

We collected the following information from patient records: date of birth, date of admission, gender, accident details, helmet use, patients' self-reported speed, diagnoses, hospitalisation days, and surgical procedures under general anesthesia.

Trauma were grouped into four categories of head trauma, fractures, internal injuries, and multiple trauma. Multiple trauma were defined as severe injury of two or more body parts (head trauma, trauma of internal organs, and fractures).

Because the law change came into effect mid-year 2011 that year was excluded from comparisons in accident features and clinical data before and after the new law.

Data for incidence estimates

Helsinki Children's Hospital is the only paediatric hospital in Helsinki and has the only paediatric ICU in the province of Uusimaa (population 1.4 million). Töölö Trauma Centre provides treatment for neurosurgical trauma, and Jorvi Hospital is the primary surgical unit for children and adolescents from Espoo, Vantaa, Kauniainen and Kirkkonummi.

Statistics on population demographics and issued moped/scooter licenses were available via Statistics Finland and the Finnish Road Safety Council [8,10]. From the annual census, we derived the population of 15-year-olds in the six cities or municipalities for which our centres serve as the primary source of specialist care (Helsinki, Espoo, Vantaa, Kirkkonummi, Kerava, and Kauniainen). These figures were used to estimate the annual incidence of hospital-treated injuries sustained from moped and scooter accidents in the population of 15-year-olds in our study area. We also obtained the national population size of 15-year-olds and nation-wide figures on new moped/scooter driver's licenses issued to 15-year-olds to estimate changes in popularity of moped/scooter licenses. Assuming a similar popularity of moped/scooter licenses in our study area, we derived an annual incidence estimate for hospital-treated injuries per license among 15-year-olds.

Statistics

Statistical analyses were performed using SPSS 19.0 statistics software (IBM, Somers, NY). Descriptive statistics include frequencies, percentages, and means (with standard deviation, SD), and in case of skewed distributions, medians (with range). Fisher's exact test was used for dichotomous variables. For continuous variables, the chi-square test and the Mann–Whitney *U*-test were used according to distribution, as appropriate. Correlations were calculated using the Pearson two-tailed test. A p value <0.05 was considered statistically significant.

Results

Patient demographics are presented in Table 1.

Accident details

In the full patient cohort, 426 patients (82%) were injured in accidents when they were driving alone, and 271 patients (52%) were injured in collisions. Self-reported speed was recorded for 334 patients (64%), and sixteen of them (5%) reported velocities exceeding 60 km/h (up to 90 km/h), thus suggesting illegal tuning of the vehicle. Data on helmet use was available for 309 patients (59%). Eight of these patients (3%) had been driving without a helmet, and in 16 cases (5%) helmets fell off.

Data on driver status, self-reported speed, accident type, and helmet use in patients before (2008–2010) and after (2012–2013) the law change are summarised in Table 2. Significant changes were noted in rates of collisions (57% before and 45% after the law change; $p = 0.034$) and for retaining an intact helmet (83% before and 92% after the law change; $p = 0.047$).

Trauma and treatment

None of the patients admitted for trauma from moped or scooter accidents died during the study period. In the complete patient cohort, fractures were the most common injury type found in 257 (49%) patients. Ninety patients (17%) were diagnosed with head trauma and 30 patients (6%) with internal trauma. Altogether

Table 1
Demographics of 520 patients according to year admitted.

	2008	2009	2010	2011	2012	2013
Patients, *n*	114	87	107	102	68	42
Boys, *n* (%)	79 (69)	61 (70)	69 (64)	74 (73)	48 (71)	29 (69)
Age 15, *n* (%)	86 (75)	68 (78)	79 (74)	94 (92)	59 (87)	36 (86)

Table 2
Accident details of patients before (2008–2010, $n = 308$) and after (2012–2013, $n = 110$) drivers' education became mandatory.

	Before, *n* (%)	After, *n* (%)
Driver status		
Driving alone	247 (80)	95 (86)
With passenger	32 (10)	8 (7)
As passenger	29 (9)	7 (6)
Speed[a]		
<20 km/h	11 (6)	6 (8)
20–45 km/h	132 (70)	56 (77)
>45 km/h	45 (24)	11 (15)
Accident type		
Fall	122 (40)	55 (50)
Collision	**175 (57)**	**49 (45)**
Undefined	11 (4)	6 (5)
Helmet status[b]		
Intact	**152 (83)**	**61 (92)**
Broken	13 (7)	2 (3)
Fell off	12 (7)	2 (3)
Not in use	6 (3)	1 (2)

[a] Data on self-reported speed available for 188 (61%) and 73 (66%) patients in before and after groups, respectively.
[b] Data on helmet status available for 183 (59%) and 66 (60%) patients in before and after groups, respectively.
Significant differences in bold (Fisher's exact test, $p < 0.05$).