JTI
JOURNAL OF
TRAUMA AND INJURY

ORIGINAL ARTICLE
J Trauma Inj 2021;34(3):147-154
https://doi.org/10.20408/jti.2020.0066

Characteristics and Outcomes of Patients with Bicycle-Related Injuries at a Regional Trauma Center in Korea

Yoonhyun Lee, M.D.[1], Min Ho Lee, M.D.[2], Dae Sang Lee, M.D., Ph.D.[3], Maru Kim, M.D., Ph.D.[3], Dae Hyun Jo, M.D., Ph.D.[3], Hyosun Park, R.N.[3], Hangjoo Cho, M.D., Ph.D.[3]

[1]Department of General Surgery, Armed Forces Capital Hospital, Seongnam, Korea
[2]Department of Neurosurgery, Uijeongbu St. Mary's Hospital, College of Medicine, The Catholic University of Korea, Uijeongbu, Korea
[3]Department of Trauma Surgery, Uijeongbu St. Mary's Hospital, College of Medicine, The Catholic University of Korea, Uijeongbu, Korea

Received: October 22, 2020
Revised: November 22, 2020
Accepted: November 26, 2020

Correspondence to
Hangjoo Cho, M.D., Ph.D.
Department of Trauma Surgery, Uijeongbu St. Mary Hospital, College of Medicine, The Catholic University of Korea, 271 Cheonbo-ro, Uijeongbu 11765, Korea
Tel: +82-31-820-5066
Fax: +82-31-820-5378
E-mail: surgeryman@catholic.ac.kr
ORCID: https://orcid.org/0000-0003-3322-744X

Purpose: We analyzed the characteristics and outcomes of patients with bicycle-related injuries at a regional trauma center in northern Gyeonggi Province as a first step toward the development of improved prevention measures and treatments.
Methods: The records of 239 patients who were injured in different types of bicycle-related accidents and transported to a single regional trauma center between January 2017 and December 2018 were examined. This retrospective single-center study used data from the Korea Trauma Database.
Results: In total, 239 patients experienced bicycle-related accidents, most of whom were males (204, 85.4%), and 46.9% of the accidents were on roads for automobiles. Forty patients (16.7%) had an Injury Severity Score (ISS) of 16 or more. There were 125 patients (52.3%) with head/neck/face injuries, 97 patients (40.6%) with injuries to the extremities, 59 patients (24.7%) with chest injuries, and 21 patients (8.8%) with abdominal injuries. Patients who had head/neck/face injuries and an Abbreviated Injury Score (AIS) ≥3 were more likely to experience severe trauma (ISS ≥16). In addition, only 13 of 125 patients (10.4%) with head/neck/face injuries were wearing helmets, and patients with injuries in this region who were not wearing helmets had a 3.9-fold increased odds ratio of severe injury (AIS ≥2).
Conclusions: We suggest that comprehensive accident prevention measures, including safety training and expansion of safety facilities, should be implemented at the governmental level, and that helmet wearing should be more strictly enforced to prevent injuries to the head, neck, and face.

Keywords: Trauma centers; Bicycling; Head protective devices; Injury Severity Score; Epidemiology

http://www.jtraumainj.org
eISSN 2287-1683
pISSN 2799-4317

INTRODUCTION

The global number of bicycle users is increasing in all age groups for economic and health-related reasons, and because bicycle riding is an increasingly popular leisure activity. The number of bicycle users in Korea has continuously increased in line with the government's goals to promote eco-friendly transportation policies and reduce urban traffic jams. In particular, there were 13,037 km of bicycle paths in 2010, and 23,000 km in 2018, a 76% increase. This was associated with a 36% increase in the number of bicycle commuters, from 20.5 million in 2005 to 27.9 million in 2015 [1-4].

The number of bicycle-related accidents has also increased according to data from the Korea Transport Institute. An analysis of bicycle accidents indicated there were 8,000 accidents in 2005 and 14,000 accidents in 2017, and about 300 deaths each year [5]. There were 3,300 accidents in Gyeonggi Province during 2017 alone, accounting for 22.9% of the nationwide total [6]. Although the number of bicycle-related accidents in Korea has increased due to the increased number of bicycle users, there is insufficient knowledge of the characteristics and prognostic indicators of these individuals. We analyzed the demographic characteristics, sites of injury, severity of injury, and prognosis of patients with bicycle-related accidents who visited a regional trauma center.

METHODS

Patient data

From January 2017 to December 2018, all 239 bicycle-related accident patients who were admitted to the regional trauma center in northern Gyeonggi Province were enrolled in this retrospective study. Patient data were extracted from annual reports submitted to the Ministry of Health and Welfare. There were no exclusion criteria. The study protocol was reviewed and approved by the Institutional Review Board (IRB No. UC20RISE0132) and adhered to the recommendations for biomedical research involving human subjects of the Declaration of Helsinki (1975).

Abbreviated Injury Score grouping

The regional trauma center in northern Gyeonggi Province routinely performs brain, chest, and abdominal computed tomography when a patient presents with a bicycle-related accident. Depending on whether the patient complains of pain and the nature of the bruises and abrasions found during examination, X-ray images of affected parts may be taken. The Abbreviated Injury Score (AIS) was evaluated by classifying the body parts into six regions (head and neck, face, chest, abdomen, extremities,

Table 1. Baseline characteristics of patients with bicycle-related injuries

Characteristic	Value (n=239)
Sex	
Male	204 (85.4)
Female	35 (14.6)
Age (years)	
≤19	51 (21.3)
20–64	122 (51.0)
≥65	66 (27.7)
Accident type	
Alone	125 (52.3)
Vehicle	86 (36.0)
Motorcycle	6 (2.5)
Bicycle	5 (2.1)
Unknown	17 (7.1)
Accident place	
Automobile road	112 (46.9)
Bicycle path	30 (12.6)
Residential area	21 (8.8)
Unpaved road	6 (2.5)
Others	70 (29.2)
Helmet	
Yes	27 (11.3)
No	212 (88.7)
GCS (brain injury)	
Mild (13–15)	231 (96.6)
Moderate (9–12)	3 (1.3)
Severe (3–8)	5 (2.1)

Values are presented as number (%).
GCS: Glasgow Coma Scale.

 https://doi.org/10.20408/jti.2020.0066

external). For a more concise analysis, these six regions were divided into four regions (head and neck [including the face], chest, abdomen, and extremities).

Statistical analysis

The chi-square test and Fisher exact test were used to measure the significance of relationships between injury severity at each trauma site in patients and severe trauma (Injury Severity Score [ISS] ≥16). These tests were used to evaluate whether the severity of head, neck, and face injuries was associated with wearing a helmet. R software version 3.6 (https://cran.r-project.org/) was used for the statistical analyses.

Table 2. Severity of bicycle-related injuries

Scoring system	Value (n=239)
ISS	
≤8	134 (56.1)
9–15	65 (27.2)
≥16	40 (16.7)
AIS	
Head, neck, and face	125 (52.3)
Chest	59 (24.7)
Abdomen	21 (8.8)
Extremities	97 (40.6)

Values are presented as number (%).
ISS: Injury Severity Score, AIS: Abbreviated Injury Scale.

RESULTS

Patient characteristics

We retrospectively examined the records of 239 bicycle accident patients, including 204 males (85.4%) and 35 females (14.6%) (Table 1). The average age was 47.5 years (range 4–92 years). A total of 122 patients (51.0%) were 20–64 years old, 51 (21.3%) were under 19 years old, and 66 (27.7%) were more than 65 years old. An analysis of accident type indicated that the bicycle-alone category accounted for 52.3% of cases (n=125), followed by bicycle-car (36.0%, n=86), bicycle-motorcycle (2.5%, n=6), and bicycle-bicycle (2.1%, n=5); finally, the type was unknown in 7.1% of cases (n=17).

An analysis of accident location indicated that automobile roads accounted for 46.9% of accidents (n=112), followed by bicycle paths (12.6%, n=30), residential areas (8.8%, n=21), unpaved roads (2.5%, n=6), and others (29.2%, n=70). Only 27 patients (11.3%) reported wearing a helmet. At the time of admission, assessments of the Glasgow Coma Scale indicated that 231 patients (96.7%) had a mild brain injury (score: 13–15), while three pa-

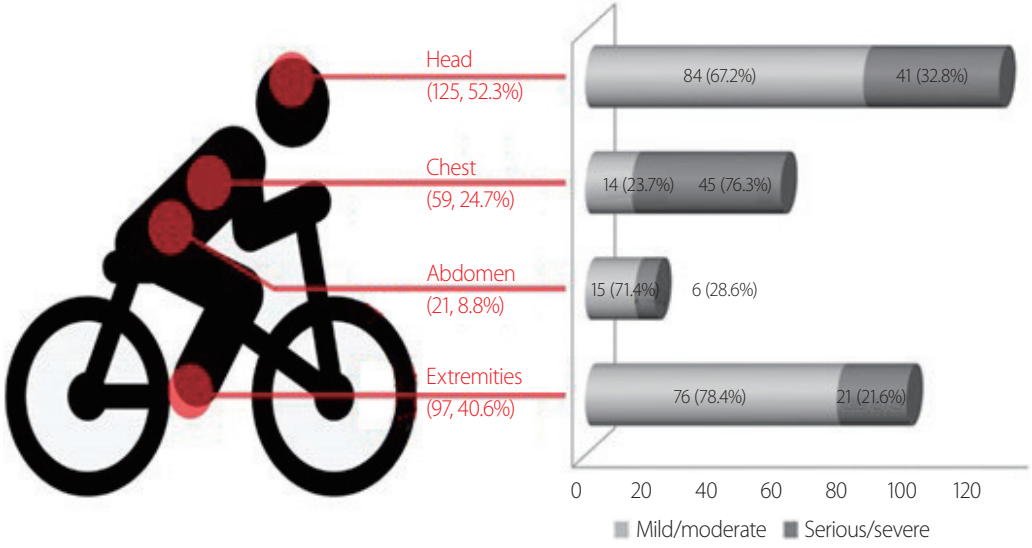

Fig. 1. Presence of minor/moderate injuries (AIS=1–2) and serious/severe injuries (AIS=3–4) in different body regions (n=239). AIS: Abbreviated Injury Scale.

tients (1.6%) had a moderate brain injury (score: 9–12) and five patients (2.1%) had a severe brain injury (score: 3–8).

Assessment of trauma severity

An analysis of the ISS (Table 2) indicated that 134 patients (56.1%) had scores of 8 or less, 65 patients (27.2%) had a suspicion of severe trauma (ISS=9–15), and 40 patients (16.7%) had severe trauma (ISS ≥16). An analysis of the AIS indicated that there were 125 patients (52.3%) with head, neck, and face injuries, 59 patients (24.7%) with chest injuries, 21 patients (8.8%) with abdomen injuries, and 97 patients (40.6%) with injuries to the extremities. We also assessed the severity of injuries (range 1–6) of different anatomical regions based on the AIS (Fig. 1). Most patients with head, neck, and face injuries (67.2%), abdominal injuries (71.4%), and injuries to the extremities (78.4%) had AIS severity scores of 1 or 2. However, 76.3% of patients with chest injuries had AIS scores of 3 or 4.

Table 3. Relationship of injury severity (AIS) and trauma severity (ISS) in different body regions

Region and severity	Number (n=239)	ISS ≤15	ISS ≥16	*p*-value
Head, neck, face	125			0.001
AIS (I–II)	84	78 (92.9)	6 (7.1)	
AIS (III–VI)	41	13 (31.7)	28 (68.3)	
Chest	59			0.440
AIS (I–II)	14	10 (71.4)	4 (28.6)	
AIS (III–VI)	45	27 (60.0)	18 (40.0)	
Abdomen	21			0.331
AIS (I–II)	15	10 (66.7)	5 (33.3)	
AIS (III–VI)	6	2 (33.3)	4 (66.7)	
Extremities	97			0.328
AIS (I–II)	76	65 (85.5)	11 (14.5)	
AIS (III–VI)	21	16 (76.2)	5 (23.8)	

Values are presented as number (%).
ISS: Injury Severity Score, AIS: Abbreviated Injury Scale.

Association of injury location and trauma severity

We next analyzed the association of injury severity at each body location with mild trauma (ISS ≤15) and severe trauma (ISS ≥16) (Table 3). The results indicated that patients with more severe head, neck, and face injuries (AIS=3–4) were significantly more likely to have severe trauma (ISS ≥16) (p=0.001).

Association of wearing a bicycle helmet and trauma severity

Our analysis of the relationship of the severity of head, neck, and face injuries with wearing a helmet (Table 4) indicated that patients who did not wear helmets had more severe injuries (AIS ≥2) than those who wore helmets (p=0.028; 95% CI 1.196–12.997).

Treatment outcomes

A total of 40 patients (16.7%) were admitted to the intensive care unit and 199 patients (83.3%) were admitted to the general ward (Table 5). However, two of the 199 patients admitted to the general ward were transferred to other hospitals that were nearer to their residences.

After hospitalization, 214 patients (89.5%) had conservative (non-surgical) treatment and 25 patients (10.5%) had an operation or other surgical intervention. Eleven patients (44.0%) underwent orthopedic surgery, five (20.0%) underwent neurosurgery (20.0%), four (16.0%) underwent plastic surgery, three (12.0%) underwent trauma surgery, and two (8.0%) underwent combined trauma and orthopedic surgery. A total of 234 patients (97.9%)

Table 4. Association of wearing a helmet with severity of trauma to the head, neck, and face

Wearing helmet	Number (n=125)	Head, neck, and face injury		*p*-value	OR
		AIS ≥2	AIS=1		
No	112 (89.6)	92 (82.1)	20 (17.9)	0.028	3.943
Yes	13 (10.4)	7 (53.8)	6 (46.2)		

Values are presented as number (%).
AIS: Abbreviated Injury Scale, OR: odds ratio.

https://doi.org/10.20408/jti.2020.0066

recovered normally and three patients (1.3%) left the hospital against medical advice (self-discharge). Two patients (0.8%) died during treatment. One patient with multiple trauma died within 48 hours after presentation, and one patient with a traumatic brain injury died 90 minutes after treatment was initiated.

DISCUSSION

From 2012 to 2014, the number of patients admitted to emergency departments in Korea due to bicycle-related accidents increased in all age groups, and 20% of these patients were elderly and about 75% were men [1]. An analysis of current data on bicycle traffic accidents in different age groups from 2016 to 2018, based on data from the Korean National Statistical Office, indicated an increase from 10% to 20% for those under age 20 years and an increase from 20% to 30% for those over age 65 years [7]. These results in terms of age and sex are similar to those of previous reports from the United States and Australia [8-10].

Table 5. Patient admissions, treatments, and outcomes

	Value
Admission	
General ward	199 (83.3)
Intensive care unit	40 (16.7)
Treatment	
Conservative	214 (89.5)
Operation or intervention	25 (10.5)
OS	11 (44.0)
Neurosurgery	5 (20.0)
Plastic surgery	4 (16.0)
AS	3 (12.0)
Combined (AS+OS)	2 (8.0)
Outcome	
Recovery	234 (97.9)
Discharge home	176 (75.2)
Transfer	58 (24.8)
Expired	2 (0.8)
Others	3 (1.3)

Values are presented as number (%).
OS: orthopedic surgery, AS: abdominal surgery.

Our study confirmed that most patients were males (85.4%), 21.3% of patients were under the age of 19 years and 27.7% were over the age of 65 years. The similar bicycle accident rates among different age groups reflect the increasing use of bicycles for various purposes, and are a consequence of the implementation of government policies that encourage the use of bicycles. Importantly, previous studies showed that children and elderly patients were most vulnerable to bicycle-related injuries and fatal outcomes [8,9,11-15]. Another of our notable findings is that only 12.6% of accidents occurred on bicycle paths and that 46.9% of accidents occurred on automobile roads. Because bicyclists mostly use bicycle paths for leisure riding, this suggests that most accidents occur among individuals who are riding a bicycle for non-leisure purposes, such as commuting to work.

In view of the increased use of bicycles by children, adolescents, and the elderly, it is necessary to implement measures that prevent bicycle accidents and to provide safety training that is specialized for different age groups. A previous study in Denmark concluded that the mortality rate due to bicycle accidents will be reduced only when a bicycle-related safety infrastructure is constructed from a city-wide perspective, and that these interventions should target both roads and bicycle paths [16].

Many studies have reported that head injuries are the leading cause of death or moderate disability due to bicycle accidents [10,11], and that wearing a helmet can reduce the severity of this injury [17,18]. A study in France reported that bicyclists who did not wear helmets had a 1.98- to 3.89-fold higher risk of head injury [19]. Another study in Canada reported that the mortality rate from bicycle accidents declined by 52% after enacting a law that mandated helmet-wearing [20].

Our analysis of the association between injury severity at different body locations and the presence of severe trauma (ISS $\geq$16) indicated that patients with more severe head, neck, and face injuries (AIS=3–6) were significantly more likely to have severe trauma (p=0.001), but there were no such associations for other body regions. In addition, only 13 of 125 patients who had head, neck, and face injuries were wearing helmets, and patients who did

not wear helmets (112) had a 3.943 higher odds ratio for head, neck, and face injuries. We also found that among patients with head, neck, and face injuries, only 10.4% wore helmets. This is lower than the rate of wearing bicycle helmets in Germany (12–15%), Finland (13%), Canada (50%), the United States (54%), and Australia (75.4%) [17,21-25].

The Korean government has steadily improved the social and public infrastructure for bicycle users, developed various education programs that promote safety, and revised the Road Traffic Act. Since September 2018, it has been mandatory to wear helmets when riding a bicycle in Korea. However, due to the lack of enforcement, the rate of wearing helmets is similar to that of other countries where there are no such laws. Accordingly, interventions to increase the wearing of bicycle helmets in Korea should be considered.

Our analysis of injuries of different body regions indicated that head, neck, and face injuries occurred in 125 patients (52.3%), chest injuries occurred in 59 patients (24.7%), abdominal injuries occurred in 21 patients (8.8%), and injuries of the extremities occurred in 97 patients (40.6%). This result is similar to previous studies, which also reported that most bicycle-related injuries occurred in the head, neck, and face and in the extremities [26,27]. Our analysis of injury severity in different body regions indicated that chest injuries had a lower incidence rate than other sites, but was found to have a relatively high severity (76.3%, AIS=3–4) (Fig. 1). Most chest injuries were managed using conservative treatment without surgery. In contrast, among the 21 patients with abdominal injuries, only six patients severe injuries (28.6%, AIS=3–4). However, among the 25 patients who underwent surgery, five patients (20%) received abdominal surgery. Thus, the rate of abdominal surgery was greater than that of chest surgery. This suggests the need for rapid transfer to a regional trauma center and prompt preparation for surgery for these patients.

The present study had several limitations. Our study was retrospective and we had no information regarding each patient's reason for using a bicycle, wearing or not wearing protective gear other than a helmet, speed at the time of the accident, and consumption of alcohol before the accident. Our results do not reflect the trends of all trauma centers, and different patterns may occur at other centers depending on the size of the city, the types of employment, and other factors. An analysis of the effect of age on the risk for accidents or mortality was not possible because of the small sample size. Finally, there was a possibility of selection bias because the patients with severe injury were likely to be transferred to a regional trauma center rather than to a nearby hospital.

CONCLUSION

We found that patients with the bicycle-related injuries had a high incidence of severe trauma (16.7%). Therefore, the government should implement comprehensive accident prevention measures, including age-specific accident prevention education programs and expanded promotion of bicycle safety. Furthermore, these patients should be transferred immediately to an appropriate regional trauma center.

Our study confirmed that wearing a helmet was associated with reduced severity of head, neck, and face injuries, but only 11.3% of our patients reported wearing helmets. We suggest that the law to wear helmets when riding a bicycle should be more strictly enforced.

REFERENCES

1. Kim YJ, Seo DW, Lee JH, Lee YS, Oh BJ, Lim KS, et al. Trends in the incidence and outcomes of bicycle-related injury in the emergency department: a nationwide population-based study in South Korea, 2012-2014. PLoS One 2017;12:e0181362.
2. The Korea Transport Institute. The current state of bicycle road extension, nationwide [Internet]. Sejong: The Korea Transport Institute 2019 [cited 2019 Dec 31]. Available from: https://www.koti.re.kr/user/bbs/BD_selectBbs.do?q_clCode=&q_searchKeyTy=sj___1002&q_searchVal=%EB%8F%84%EB%A1%9C&q_bbsCode=1012&q_bbscttSn=20200324101312877&q_rowPerPage=10&q_currPage=1&q_bbsSortType=&.
3. Statistics Korea. 2015 population census [Internet]. Daejeon: Statistics Korea 2016 [cited 2017 Jun 8]. Available from: http://kosis.kr/statisticsList/statisticsList_01List.jsp?vwcd=MT_ZTI-

 https://doi.org/10.20408/jti.2020.0066

TLE&parentId=A-SubCont.
4. Statistics Korea. 2010 population census [Internet]. Daejeon: Statistics Korea 2011 [cited 2017 Jun 8]. Available from: http://kosis.kr/statisticsList/statisticsList_01List.jsp?vwcd=MT_ZTITLE&parentId=A-SubCont.
5. The Korea Transport Institute. The current state of bicycle traffic accidents, nationwide [Internet]. Sejong: The Korea Transport Institute 2019 [cited 2019 Dec 31]. Available from: https://www.koti.re.kr/user/bbs/BD_selectBbs.do?q_clCode=&q_searchKeyTy=sj___1002&q_searchVal=%EC%82%AC%EA%B3%A0&q_bbsCode=1012&q_bbscttSn=20200324105002224&q_rowPerPage=10&q_currPage=1&q_bbsSortType=&.
6. The Korea Transport Institute. The current state of bicycle traffic accidents by city and district [Internet]. Sejong: The Korea Transport Institute 2019 [cited 2019 Dec 31]. Available from: https://www.koti.re.kr/user/bbs/BD_selectBbs.do?q_clCode=&q_searchKeyTy=sj___1002&q_searchVal=%EC%82%AC%EA%B3%A0&q_bbsCode=1012&q_bbscttSn=20200324105202170&q_rowPerPage=10&q_currPage=1&q_bbsSortType=&.
7. The Korea Transport Institute. The current state of bicycle traffic accidents by age group, 2016-2018 [Internet]. Sejong: The Korea Transport Institute 2019 [cited 2019 Dec 31]. Available from: https://www.koti.re.kr/user/bbs/BD_selectBbs.do?q_clCode=&q_searchKeyTy=sj___1002&q_searchVal=%EC%97%B0%EB%A0%B9&q_bbsCode=1012&q_bbscttSn=20200324105448803&q_rowPerPage=10&q_currPage=1&q_bbsSortType=&.
8. Chen WS, Dunn RY, Chen AJ, Linakis JG. Epidemiology of nonfatal bicycle injuries presenting to United States emergency departments, 2001-2008. Acad Emerg Med 2013;20:570-5.
9. Hamann C, Peek-Asa C, Lynch CF, Ramirez M, Torner J. Burden of hospitalizations for bicycling injuries by motor vehicle involvement: United States, 2002 to 2009. J Trauma Acute Care Surg 2013;75:870-6.
10. Sikic M, Mikocka-Walus AA, Gabbe BJ, McDermott FT, Cameron PA. Bicycling injuries and mortality in Victoria, 2001-2006. Med J Aust 2009;190:353-6.
11. Yeung JH, Leung CS, Poon WS, Cheung NK, Graham CA, Rainer TH. Bicycle related injuries presenting to a trauma centre in Hong Kong. Injury 2009;40:555-9.
12. Scheiman S, Moghaddas HS, Björnstig U, Bylund PO, Saveman BI. Bicycle injury events among older adults in Northern Sweden: a 10-year population based study. Accid Anal Prev 2010;42:758-63.
13. Lustenberger T, Inaba K, Talving P, Barmparas G, Schnüriger B, Green D, et al. Bicyclists injured by automobiles: relationship of age to injury type and severity--a national trauma databank analysis. J Trauma 2010;69:1120-5.
14. Ekman R, Welander G, Svanström L, Schelp L, Santesson P. Bicycle-related injuries among the elderly--a new epidemic? Public Health 2001;115:38-43.
15. George PE, Vidal J, Garcia PJ. An analysis of and recommendations for the peruvian blood collection and transfusion system. J Epidemiol Public Health Rev 2016 Apr 22. doi: 10.16966/2471-8211.119 [Epub ahead of print].
16. Kaplan S, Vavatsoulas K, Prato CG. Aggravating and mitigating factors associated with cyclist injury severity in Denmark. J Safety Res 2014;50:75-82.
17. Bambach MR, Mitchell RJ, Grzebieta RH, Olivier J. The effectiveness of helmets in bicycle collisions with motor vehicles: a case-control study. Accid Anal Prev 2013;53:78-88.
18. Elvik R. Publication bias and time-trend bias in meta-analysis of bicycle helmet efficacy: a re-analysis of Attewell, Glase and McFadden, 2001. Accid Anal Prev 2011;43:1245-51.
19. Amoros E, Chiron M, Martin JL, Thélot B, Laumon B. Bicycle helmet wearing and the risk of head, face, and neck injury: a French case--control study based on a road trauma registry. Inj Prev 2012;18:27-32.
20. Wesson DE, Stephens D, Lam K, Parsons D, Spence L, Parkin PC. Trends in pediatric and adult bicycling deaths before and after passage of a bicycle helmet law. Pediatrics 2008;122:605-10.
21. Ritter N, Vance C. The determinants of bicycle helmet use: evidence from Germany. Accid Anal Prev 2011;43:95-100.
22. Orsi C, Ferraro OE, Montomoli C, Otte D, Morandi A. Alcohol consumption, helmet use and head trauma in cycling collisions in Germany. Accid Anal Prev 2014;65:97-104.
23. Airaksinen N, Lüthje P, Nurmi-Lüthje I. Cyclist injuries treated in emergency department (ED): consequences and costs in South-Eastern Finland in an area of 100 000 inhabitants. Ann Adv Automot Med 2010;54:267-74.
24. Page JL, Macpherson AK, Middaugh-Bonney T, Tator CH. Prevalence of helmet use by users of bicycles, push scooters, inline skates and skateboards in Toronto and the surrounding area in the absence of comprehensive legislation: an observational study. Inj Prev 2012;18:94-7.
25. Fischer CM, Sanchez CE, Pittman M, Milzman D, Volz KA,

Huang H, et al. Prevalence of bicycle helmet use by users of public bikeshare programs. Ann Emerg Med 2012;60:228-31.
26. Frank E, Frankel P, Mullins RJ, Taylor N. Injuries resulting from bicycle collisions. Acad Emerg Med 1995;2:200-3.
27. Ortega HW, Shields BJ, Smith GA. Bicycle-related injuries to children and parental attitudes regarding bicycle safety. Clin Pediatr (Phila) 2004;43:251-9.

 https://doi.org/10.20408/jti.2020.0066