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Identify Factors that Contribute to the Severity of Motorcycle Crash: A Scientometric Analysis

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Abstract

Motorcycles are one of the most widely used travel modes in many developing countries, and therefore motorcycle crashes are more dangerous than other vehicles, as for every mile traveled by vehicles, the rate of motorcycle crashes increases. Therefore, many factors contribute to increasing the rate of injuries, including not following safety rules, such as wearing a helmet, exceeding the permitted speed, using things that distract the leg, drinking alcohol, and other factors that help increase the rate of injuries. Motorcycle crashes remain a significant public health concern worldwide, with severe consequences for riders and other road users. Understanding the factors contributing to the severity of motorcycle crashes is crucial for developing effective interventions to reduce their impact. This study presents a scientometric analysis aimed at identifying and synthesizing the key factors associated with the severity of motorcycle crashes. Through a systematic review of the literature using scientometric techniques, including co-occurrence analysis and citation analysis, we examined trends, patterns, and relationships among factors influencing crash severity. Our analysis revealed several prominent factors contributing to the severity of motorcycle crashes, including rider characteristics (e.g., age, experience), environmental factors (e.g., road conditions, weather), vehicle-related factors (e.g., type of motorcycle, helmet use), and behavioral factors (e.g., speeding, alcohol impairment). Additionally, we identified emerging areas of research, such as the influence of advanced safety technologies and the impact of urbanization on motorcycle crash severity.

Keywords: Injury patterns, Injury severity, Motorcycle crash, Scientometric analysis.

Introduction

Motorcycle crashes are a major global public health concern that result in a high burden of injury, death, and financial expenses. Motorcycle-related fatalities and injuries continue to be a major source of worry for public health authorities, legislators, and road safety advocates despite improvements in vehicle safety and road infrastructure. In order to effectively lessen the effects of motorcycle collisions and enhance road safety generally, it is imperative to comprehend the elements that contribute to the severity of these crashes.

A variety of intricately interacting factors, including as rider traits, surrounding circumstances, vehicle-related factors, and behavioral elements, might affect how severe motorcycle collisions are. However, the lack of a thorough synthesis of the body of research on

this subject makes it more difficult for us to pinpoint major themes, important variables, and specific areas that require focused action.

This study uses a scientometric methodology to methodically review and synthesize the literature on factors contributing to the severity of motorcycle collisions in order to fill in this knowledge gap. A thorough and impartial approach to mapping a study field's intellectual structure, recognizing significant works, and spotting new trends and patterns is provided by scientometric analysis. Using scientometric methods such as co-occurrence and citation analysis, Thus, a comprehensive picture is presented of the variables that affect the severity of motorcycle accidents and how they relate to each other

By means of this scientometric analysis, we aim to accomplish many goals:

1. List the most often researched variables related to the severity of motorcycle crashes.
2. Investigate the linkages and connections between these elements to clarify intricate causal chains.
3. Determine regions and gaps in the knowledge about the severity of motorcycle crashes.

This study attempts to add to the body of knowledge on motorcycle safety by integrating the results from a wide range of studies and provide insightful information to practitioners, academics, and policymakers working in the subject of road safety. Our ultimate objective is to provide guidance for evidence-based initiatives and regulations that attempt to lessen the severity of motorcycle accidents while also enhancing rider and other road user safety. Motorcyclists are 34 times more likely to be involved in a motorbike accident for every little distance driven by a car. Bicycles are therefore almost twice as likely to cause injuries as other kinds of vehicles [1].

Research has indicated that the degree of harm inflicted upon motorcyclists is contingent upon their age, visual acuity, and other vehicles on the road [2, 3]. But both studies showed that there are variables that can be changed. such as donning a helmet, abusing alcohol or other drugs, lacking experience in driver education, failing to verify ownership and license, speeding, and engaging in risky conduct. Since they have recently been linked to an increased risk of motorcycle accidents, this review looks at the trends, protective, and risk factors of motorcycle injuries as well as the characteristics of motorcycle use and potentially useful preventative initiatives to lessen the harm caused by motorcycle accidents in developing nations. Bicycle injuries are not treated differently from motorcycle injuries in this review; yet, the conclusions on motorcycle injuries with reference to the topics covered in this study are comparable to those on bicycle injuries [4].

Contribution factor on injury pattern types

Injury patterns in motorcycle accidents can vary depending on several factors such as the speed of the collision, the type of motorcycle, the use of protective equipment, and the nature of the accident. However, some common injury patterns observed in motorcycle accidents include head and neck injuries, orthopedic injuries, road rash, soft tissue injuries, chest and abdominal injuries, spinal cord injuries, facial injuries, and psychological injuries. Therefore, injuries to the lower extremities and head are the most common in motorcycle accidents, and the high death rate, the need for surgery in the majority of patients, and long admission days require motor

control and urgent care. However, the high mortality rates resulting from head injuries require significant efforts to adopt helmet laws for riders and riders [5].

Motorcycle Helmets

Wearing a helmet is one of the important things for a motorcycle rider, as it plays an important role in preventing head injury when a collision occurs.. Traumatic brain injuries (TBIs) can occur even when riders are wearing helmets, although helmet use significantly reduces the risk of fatal head injuries. In crashes where helmets are not worn, head injuries can range from minor concussions to severe skull fractures and intracranial hemorrhages. The usage of helmets significantly reduces the risk of motorcycle injuries during collisions. According to studies assessing the efficacy of helmet use among motorcycle riders, wearing one can minimize head injuries by 72% [3, 6] and a 42% decrease in the chance of passing away [6]. The first step toward safety is acquiring a helmet, but it also has to be worn, securely attached, and undamaged. Compared to other helmet types, full-face helmet use has demonstrated a much larger impact in lowering the risk of head injuries [7, 8].

Alcohol and other Drug Use

Motorcycle crashes can be significantly impacted by alcohol and drug usage. A rider's entire ability to drive a motorbike is compromised when they are intoxicated, as well as their coordination, judgment, and response time. As a result, the likelihood of having an accident significantly increases. The direct effect, which takes into account alcohol consumption, and the indirect influence of alcohol-consuming behaviors are the two methods used to assess the relationship between alcohol use and the risk of traffic injuries [9]. According to earlier research, motorcycle riders who consume alcohol are more likely to drive under the influence and engage in unsafe driving practices [10]. Comparable side effects might result from using different medicines, both prescription and illegal, Cocaine, marijuana, opioids, and sedatives are among the drugs that impair perception, motor coordination, and attention span. Additionally, they might make you feel exhausted or dizzy, which would make it more difficult for you to control your motorcycle.

Age and Gender

One of the main topics in traffic safety study is the effect of age, gender, education level, and marital status on motorcycle collisions. Remembering that there are always outliers and that these broad trends are unpredictable is crucial. Wearing protective clothing, adhering to safety procedures, and having prior riding experience are additional crucial prerequisites. The risk of suffering a traffic injury increases between the ages of 21 and 29. After that, it starts to decrease until the age of 60 or 69 [11, 12]. In addition, compared to older and female drivers, young male drivers under 30 had a higher chance of suffering fatal injuries [13]. Male drivers under 30 are more likely than female drivers of the same age to participate in unsafe driving behaviors, according to earlier research [13, 14].

Ownership of a License and Prior Driving Experience

Motorcycle crashes can be greatly influenced by a driver's experience and license status. Use of a helmet and protective clothes all lessen the severity of injuries, while good training and adherence to safety guidelines and regulations while driving lower the likelihood of major

injuries during crashes [15]. In many nations, riding a motorbike without a driving license increases the danger of significant injuries and crashes [16]. Therefore, the necessary measures are taken in the absence of a valid license, making it a basic condition when purchasing a motorcycle, strict application of licensing laws, and strict penalties in the event of a deficiency. Licensing and forcing the elderly to obtain a motorcycle driving license [17]. In conclusion, license ownership and driving experience have a direct impact on motorcycle crash likelihood. Proper training, knowledge of traffic laws, experience, confidence, defensive riding, and ADHD.

Traffic Volume and Land Use

Traffic volume and land use can have a significant impact on motorcycle crash rates. Higher traffic volume typically increases the risk of motorcycle crashes due to the increased exposure to other vehicles and potential conflict points. When there is heavy traffic, motorcycles have less space to maneuver, making it difficult for riders to react to sudden changes in traffic flow. This may result in more crashes, particularly in crowded cities with heavy traffic. Studies and research have found that increasing the density of traffic volumes leads to a reduction in speed among motorcyclists, and this leads to a reduction in serious injuries [18]. The ground can also be used outside the traffic environment playing a role in road traffic crashes. Research has shown that intersections of major and residential roads, business and entertainment districts, and locations close to bus stops can all increase the risk of traffic accidents mishaps and injuries [19]. Furthermore, crash rates may be impacted by the layout and state of the roads. Motorcycles are less stable and smaller than other vehicles, therefore hazards like potholes, debris, and poor road maintenance can be more dangerous for them. Additionally confusing and raising the possibility of accidents are poor signs and ambiguous road markings. Land use and traffic volume must be taken into account when developing urban development and transportation strategies in order to lower the number of motorcycle crashes. The implementation of various strategies, such as separating motorcycle lanes, enhancing road infrastructure, enforcing speed limits, intensifying public awareness campaigns, and promoting driver education regarding motorcycle awareness, can effectively mitigate the risks linked to traffic volume and land use in motorcycle crashes.

Day of the Week and Time of Day

The day of the week and time of day may have an impact on motorcycle collisions. Other factors that are taken into account are the volume of traffic, visibility, driver fatigue, and alcohol consumption patterns. The time of day appears to have an impact on motorcycle crashes, according to research [20, 21]. There is a higher chance of injury in an accident when driving at night [22, 23]. Thus, many serious injuries are caused by extended work hours or drinking alcohol and driving at night [24, 25]. During the peak period, which includes the morning and evening rush hours, there is typically an increase in road congestion, because there will be more cars on the road and a chance of driver distraction, this might raise the risk of motorcycle collisions. In addition, low vision at night, morning, or twilight can make it harder for vehicles to see each other and for motorcycle riders, which raises the possibility of collisions. This can increase the likelihood of motorcycle crashes due to the increased number of vehicles and the potential for driver distractions. Additionally, poor visibility conditions during dawn, dusk, or nighttime can make it more challenging for both motorcyclists and drivers to see each other, increasing the risk of crashes.

Data collection

Supporting academic and scientific research is the aim of dimensions, an online resource that contains several research datasets from previous studies. It gives you access to several databases that serve as information sources for specialized study. This permits users to conduct in-depth searches within certain academic and scientific study domains. Robust common data correlations serve as the basis for all of these bibliometric techniques that summarize earlier studies. In light of the founder's intensity, nodes, and lines on the map-which show the level of relationship between the annotated items (writers, nations, references, and keywords) in the academic mapping the authors or co-citing work that is included in the same paper references are organized into collections [26]. Scientific metric analysis is a statistical technique for determining the direction and rate of growth in any industry. The dimensions website was chosen for the current investigation as it is a reliable source of bibliographic information and has been recommended by a large number of scholars [27].

Following the removal of all irrelevant materials, 5891 publications could be found inside the Dimensions. Table 1 presents the categorization of the acquired documents according to dimension categories. About 0.578% of the total was made up of engineering, which is the least attractive topic were (computer sciences to build, create, and handle commerce, tourism, management, and services). The papers were published in the year then as seen in Fig. 1. The graph clearly shows the annual growth of publications, which is occurring at an exponential rate we notice an increase in the rate of publication of research related to accidents gradually as the years progress, with the highest rate of publication in the year 2022 due to increased awareness and guidance for drivers and the establishment of controls and restrictions related to driving.

Table 1. Records of the publications that were retrieved according to dimensions categories

Categories on the (D)	Record count	% of 10200
Engineering	5891	0.578
Commerce, management, tourism, and services	2305	0.226
Information and computation sciences	753	0.0738
Built environment and design	420	0.0412
Health Sciences	189	0.0185
Chemical sciences	133	0.0130
psychology	123	0.0120
Biomedical and clinical sciences	55	0.005
Earth sciences	54	0.005
Human society	51	0.005
Physical sciences	47	0.004
Mathematical sciences	42	0.004
Law and legal studies	38	0.003
Philosophy and religious studies	19	0.002
Biological sciences	16	0.002
Environmental Sciences	14	0.001
Creative arts and writing	13	0.001
Education	12	0.001

Language, communication, and culture	10	0.001
Economics	6	0.001
History, heritage, and archaeology	6	0.001
Agricultural, veterinary, and food sciences	3	0.001

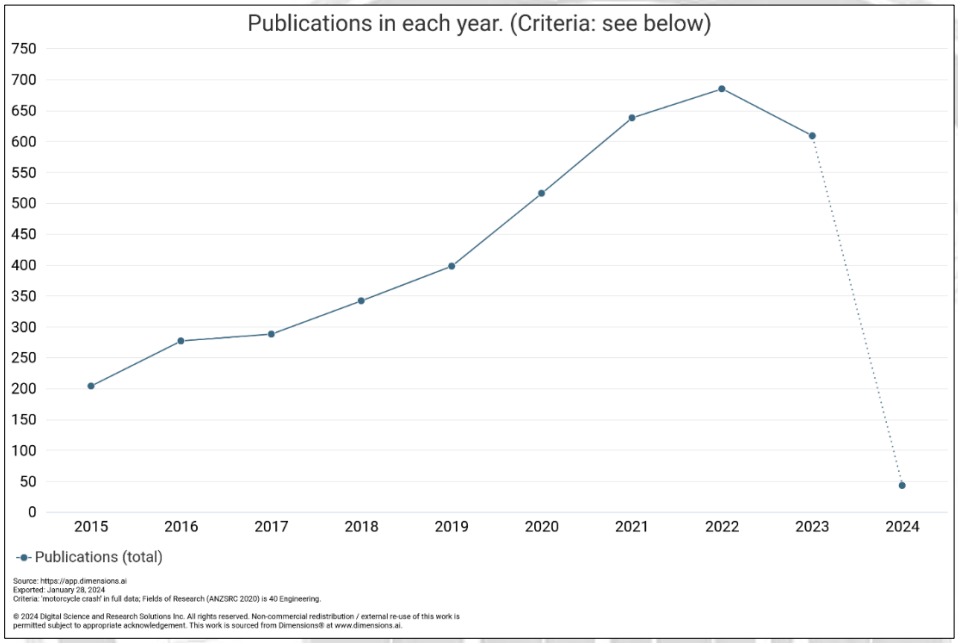

Figure 1. The relationship between year and publication number

Analytical Method

Bibliometric measurements are considered one of the most widespread measurements that are used in searching for texts and articles in all other disciplines, especially for quantitative evaluations, thus making it easier for the researcher or user to access the required information accurately.

Application programs have been developed and modified to implement bibliometric measurements, including Bib Excel, Vos Viewer, Pajek, Gephi, CiteSpace, and Histset. In this study, a VOS viewer was used to create bibliometric and visual mapping. VOS viewer is a programming application that enables you to create maps using network data and then visualize them explore those maps. There are three types of visuals in VOS viewer Grid visualizations, overlay visualizations, and density perceptions.

Co-Authorship Measures

Figure 2 shows a map of the most prominent authors123 items (12 clusters) who discussed motorcycle accidents, the factors that cause them, joint research, and collaboration among them. The elements are represented and categorized by circles.

Various sizes and colors, the elements are connected by lines representing relationships between items. The thick lines represent the strongest connection between elements, as the distance between the elements shows their degree of presence.

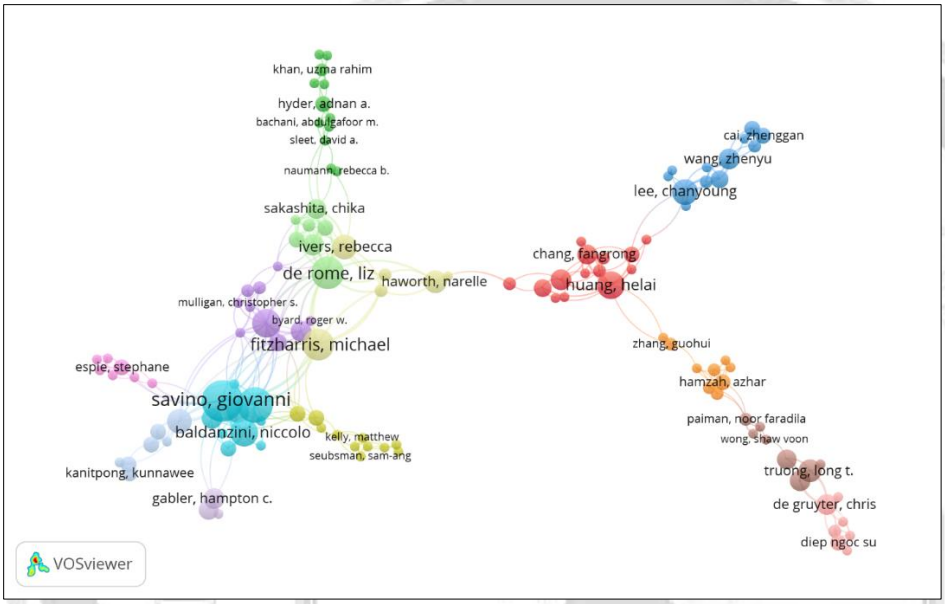

Figure 2. Network visualization map of the author

The overarching power of co-authorship connections with other writers is calculated. Writers with the most overall link strength are selected. The larger the node, the more influential the author. The most important writers include Savino, Giovanni, Baldanzini, Niccolò, Huang Hilai, Derome Lis, Fitzaris, Mimichael, Lee, and Chan Young. He has conducted many types of research on motorcycle accidents. Whenever researchers are within one group or group, this indicates the degree of cooperation and proximity to the other sharing between researchers.

Institutes Map

Figure 3 shows many of the university's 223 items (20 clusters) that contributed to the work, and some of the most important and most researched groups are Monash univ, University Florida, Iran University Sci. & Technol, Taipei Med Univ., Southeast Univ., insurance highway safety and other.

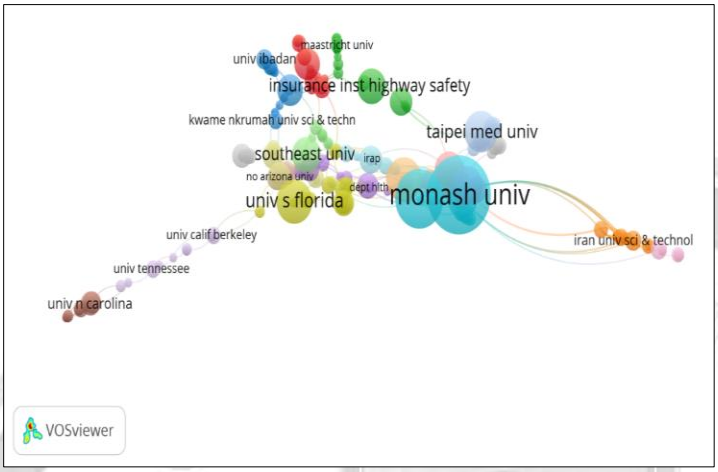

Figure 3. Institutions map

Country Map

The network map shows all countries that have published several studies related to motorcycle crashes, resulting in 58 items (13 groups), where USA, Australia, China, Taiwan, Italy, India, Malaysia, and Iran. These countries have published a lot of research that helps in linking and resolving the factors causing crashes as shown in Fig. 4.

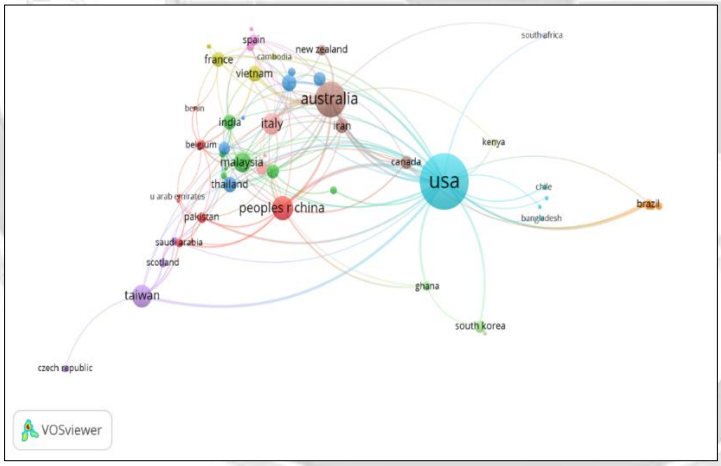

Figure 4. A network of countries publishes studies related to motorcycle crashes

Co-occurrence Measures

Figure 5 shows many keywords linked by the networks, each of which has its color, as it branches and connects with other words used by the author, and they are classified according to the size of the circles depending on their influence and most use in the search engine, where we notice many keywords that can be used to find the most prominent research that links Motorcycle accidents, the factors that cause them, and how to reduce them, thus helping the researcher to quickly reach his requirements, as the researcher notices that the large nodes

represent the most frequently used keywords, and the connected line represents the degree of closeness between these words, and thus many keywords are shared in one search.

Figure 6 shows a density visualization map of common events, such as the severity of crashes, the factors causing them, and prevention methods.

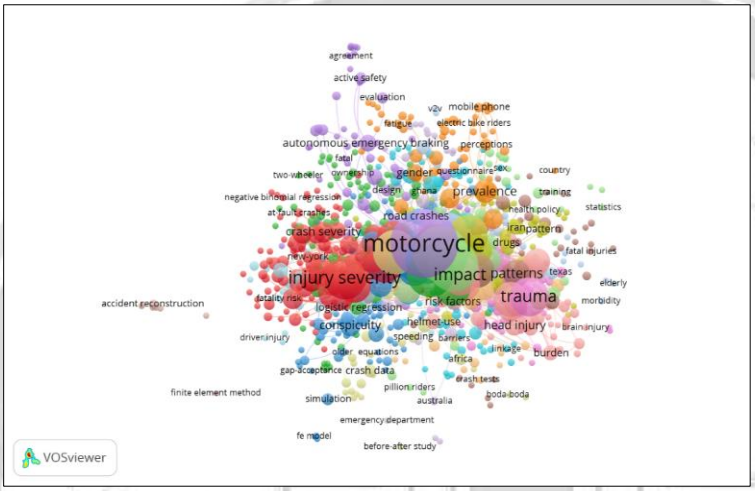

Figure 5. Keywords linked by the networks

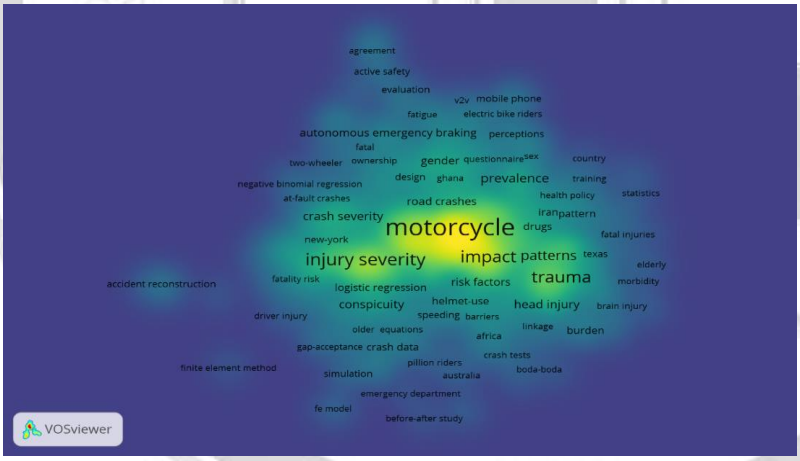

Figure 6. Density visualization map of common events

Conclusion

Since motorcycle wrecks are the most frequent accidents worldwide, determining what causes them will determine how bad the accident is. Researchers like Savino, Giovanni, Baldanzini, Niccolò, Huang Helai, Diromellis, Fitzaris, and Mimichelles—who have written on crashes, their link to surrounding circumstances, and the degree of cooperation—met via the FAS program. In addition, Lee Chan-young listed the leading nations that are engaged in the study topic; these nations are thought to have more sway than others, including the US, Australia, China, Taiwan, Italy, India, Malaysia, and Iran. The following universities also made contributions to the research: Taipei Medical University, Southeast University, Monash University, University of Florida, Iran University of Science and Technology, and Highway

Safety Insurance. Through the comprehensive synthesis of results from several research, this scientometric study offers significant insights into the complex nature of motorcycle collision severity. The creation of focused initiatives and policies aiming at lessening the severity of motorcycle collisions and enhancing general road safety for riders and other road users may be informed by the identified variables. This study also emphasizes how critical it is to carry out further research in order to fill in knowledge gaps and improve our comprehension of the intricate dynamics involved in motorbike collisions.

Motorcyclists and other road customers have to prioritize reducing motorbike injuries and improving protection. The following tips are furnished:

1. Put on the proper safety device: Make sure you are carrying a helmet that satisfies protection regulations and some other defensive garb, together with boots, coats, and gloves. In the event of an accident, this could substantially lower the risk of damage.
2. Get hold of the necessary training and licensing: Before using a motorbike on a public road, a rider must skip a formal bike protection direction and obtain a motorbike license. These instructions include protecting driving techniques, traffic laws, and fundamental driving abilities.
3. Routine preservation: To assure that a bike's mechanical circumstance is superb, it needs to be well maintained. Check the tires, brakes, lights, and other important parts on a everyday foundation, and feature any issues constant proper away.
4. Be noticeable: It's essential to face out from the crowd at the same time as using a bike considering the fact that they may be smaller and less conspicuous than other automobiles. Use your headlights always, put on reflective or vividly colored garments, and alert different drivers together with your arms and signals.
5. Ride defensively: Pay attention for your surroundings and foresee any dangers. Keep a safe following distance, steer out of larger automobiles' blind zones, and use caution at the same time as converting lanes and approaching crossings. Riding defensively might also help you in responding rapidly to any threats.
6. Respect visitor’s laws: Pay interest to all published pace limits, lane markers, and traffic symptoms. Steer clean of volatile activities including rushing, weaving through traffic, and using even as intoxicated.
7. Remain centered and prevent distractions: Refrain from the use of cellphones or indulging in different sports that divert your interest from the street. Remain concentrated on the paintings at hand, and be geared up for any unexpected instances.
8. Take under consideration extra schooling for riders: Advanced training applications or protecting riding for riders with greater revel in

Summary

The literature evaluation on bike collisions indicates severa variables contributing to the prevalence and severity of those occasions. Research shows that the leading reasons of motorcycle collisions are human mistake, along with speeding, alcohol impairment, and

inexperience. Additionally, environmental variables like road situations and weather have a essential affect. The effect of helmet utilization on reducing deaths and critical accidents is well-documented, underlining the want of helmet regulations and guidelines. Moreover, studies have studied the usefulness of safety initiatives, which includes superior rider education applications and better avenue infrastructure, in reducing the risks associated with motorbike riding. Overall, the proof underlines the need for comprehensive measures that cope with each behavioral and environmental factors to sell motorbike protection and reduce the frequency of accidents.

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تحديد العوامل التي تساهم في شدة حوادث الدراجات النارية: تحليل علمي

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الخلاصة

تعتبر الدراجات النارية واحدة من أكثر وسائل النقل استخدامًا في العديد من البلدان النامية، وبالتالي فإن حوادث الدراجات النارية أكثر خطورة من المركبات الأخرى، حيث أن معدل حوادث الدراجات النارية يرتفع مع كل ميل تقطعه المركبات. لذلك، تساهم العديد من العوامل في زيادة معدل الإصابات، بما في ذلك عدم اتباع قواعد السلامة، مثل ارتداء الخوذة، وتجاوز السرعة المسموح بها، واستخدام الأشياء التي تشتت انتباه الساق، وشرب الكحول، وعوامل أخرى تساعد في زيادة معدل الإصابات. تظل حوادث الدراجات النارية مصدر قلق كبير للصحة العامة في جميع أنحاء العالم، مع عواقب وخيمة على الدراجين ومستخدمي الطرق الآخرين. إن فهم العوامل التي تساهم في شدة حوادث الدراجات النارية أمر بالغ الأهمية لتطوير تدخلات فعالة للحد من تأثيرها. تقدم هذه الدراسة تحليلاً علميًا يهدف إلى تحديد وتلخيص العوامل الرئيسية المرتبطة بشدة حوادث الدراجات النارية. من خلال مراجعة منهجية للأدبيات باستخدام تقنيات علمية، بما في ذلك تحليل التزامن وتحليل الاستشهادات، قمنا بفحص الاتجاهات والأنماط والعلاقات بين العوامل المؤثرة على شدة الحادث. وقد كشف تحليلنا عن عدة عوامل بارزة تساهم في شدة حوادث الدراجات النارية، بما في ذلك خصائص الراكب (مثل العمر والخبرة)، والعوامل البيئية (مثل ظروف الطريق والطقس)، والعوامل المتعلقة بالمركبة (مثل نوع الدراجة النارية واستخدام الخوذة)، والعوامل السلوكية (مثل السرعة وتعاطي الكحول). بالإضافة إلى ذلك، حددنا مجالات بحثية ناشئة، مثل تأثير تقنيات السلامة المتقدمة وتأثير التحضر على شدة حوادث الدراجات النارية.

الكلمات الدالة: أنماط الإصابة، شدة الإصابة، حادث دراجة نارية، التحليل العلمي.