A cross sectional study on urban motorcyclist obedience: do road types give any impact?

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Abstract. Transportation is critical to sustainable development; it enhances economic growth and accessibility. The increase number of vehicles produced and used around the world for economic purpose also increases the number of traffic accidents. Traffic accidents is one of the highest cause of mortality and disability, therefore, the World Health Organization urges to reduce the number of global deaths and injuries from road traffic accidents through system improvements and access to road safety as mentioned in the third and eleventh Sustainable Development Goals target and the Global Plan. National Police Corps data, 2017, shows that the number of motorcycle accidents was five times higher than other types of vehicle accidents. This research aims at finding out the relationship between the types of road traversed and motorcyclist helmet use obedience. Chi-square test indicated a significant association with medium effect size (p<.01). The highest disobedience occurred in local road types (76%), followed by collective and arterial (22.2% and 1.8% respectively). Thus, control in the helmet use especially in local and collective roads has to be increased.

1. Introduction

In the year 2015, road traffic injuries (RTI) was ranked 10th as the cause of death globally and was estimated to ranked 7th in the year 2030. Death resulting from traffic accidents occurred as high as 90% in low- and middle- income countries, of two-fold compared to high income countries [1]. As a response, World Health Organization (WHO) stipulates RTI prevention as one of the sustainable development goals (SDGs) specified in the 3rd and 11th targets, and focused on high-risk countries.[2] In accordance to the SDGs target, the United Nation (UN) proclaims a resolution draft regarding road safety improvement through global planning and decade of action for road safety implementation.[3]
The majority of people injured in traffic accidents were pedestrian, motorcyclist, and bicyclist.[1] The second and fourth pillars in the planning of global decade of action for road safety prioritize those who were at risk and protect road users through good prevention and regulation. [2, 3] It has been known that the aforementioned high-risk groups are concentrated on smaller roads, such as local and collective roads.

In Indonesia, traffic accident ranked 8th as the cause of death in 2014. [4] According to WHO data, Indonesia ranked 5th among the highest mortality resulting from traffic accidents. [5] West Java is a province with the highest dense population in Indonesia. [4] Bandung as the capital of the province is the city where the population is concentrated. Moreover, West Java is among the five provinces with the highest incidence of traffic accidents in Indonesia with 1,671 accidents within the last 3 months (from January to March 2018). [6] According to Bandung City Health Profile, traffic accidents in the year 2015 caused 98 (2.43%) death and ranked 10th as the cause of death. [7,8] Furthermore, 72% injuries and deaths due to traffic accidents occurred among motorcyclist. [9]

Based on internal report of violation inspection during decade of action for road safety program conducted by Bandung City Metropolitan City Police of Bandung City (POLRESTABES Kota Bandung), between January to March 2018, there were 11,057 violations comprised of: not using a helmet, drunk and driving, speeding, not using safety belt and child seat, using hand phone and driving, and one direction road violation. Almost 35% of all the violations was driving a motorcycle without a helmet.

City department of transportation is responsible for the socialization of regulations stipulated by the Ministry of Transportation regarding the rules for driving. Regulations regarding basic safety tools, which have to be used by drivers and passengers, are in the Ministerial Regulation no. 111 of 2015 and Law No. 22 of 2009, stating that motorcycle users (drivers and passengers) have an obligation to use national standardized helmet. Motorcyclist has the highest rate of injury and death among other road users, and drivers are more likely to be harmed (55-57%) compared to the passengers (14-18%). [9]

Helmet usage reduces the risk of head injury and death among motorcyclist, and the risk is doubled in those who do not use helmet. [10] In Cambodia, helmet usage had been proven protective and is an effective public health intervention in reducing the number of head injury significantly. [11] The rate of head injury and death in Vietnam was also reduced significantly after an implementation of a regulation requiring motorcyclist to use a helmet. [12]

Traffic accidents are a result of multiple factors related to traffic system, environment, vehicles, and users, and interactions of these factors. [13] Types of the road are also one of the factors involved. According to Ministerial Regulation no. 111 of 2015, inner city roads are divided into arterial road, collective road, and residential (local) road. The maximum speed limit is differentiated based on the type of the road; 50 km/hour for arterial and collective road, and 30km/hour for residential road. The difference of the road types is also correlated with the users’ obedience.

As a solution to problems related to road safety, one of the initial measures is to understand the risk factors attributed to users and road conditions, incidence rate, and the characteristics of the accidents. In line with the Presidential Instruction (Inpres, Instruksi Presiden) No. 4 of 2013 regarding decade of action for road safety program, road safety research, injury surveillance, integrated information system, and improvement of road safety regulations should be prioritized in order to reduce the rate of accidents.

To gain an understanding of the risk factors, data regarding violations and road user’s characteristics are needed. Unfortunately, data resources in most developing countries are limited, scattered, and incomplete. Meanwhile, the information is needed to determine the appropriate intervention methods and prevention. [14]

The motorcyclist’s obedience of using helmet in different types of roads in Bandung City has never been studied. This research is the first to describe the characteristics of motorcyclists and to examine the association between the motorcyclist obedience to use helmet with the types of road in Bandung City.
2. Research Methods
The motorcyclist helmet usage obedience is identified as dependent variable. Primary data was collected through direct observation by trained field surveyor towards observable vehicles in 10 point previously-determined locations in Bandung City roads. Obedience in using helmet is defined as using helmet with or without locking the straps, since there was no specific regulation regarding locking the straps.

Of all the observation locations, four were arterial roads, four were collective roads, and two were residential roads. The types of the roads are the independent variable in this study. Data collection conducted within two weeks between August and September 2017 and was done three times a week, twice in weekdays and once during weekend. On each day between 7 am and 6 pm, there were five observations which lasted for 90 minutes. Data collected includes the role of the motorcycle users (driver or passenger), age, and gender.

Each observation also collected whether condition, presence of a law enforcement officer, and volume of vehicles during the first 15 minutes of observation. Observations with incomplete data are excluded. Statistical analysis used is non-parametric Chi-square test, followed by post-hoc test using SPSS v.22. The obedience according to research subjects’ characteristics is also described in this research.

3. Results and Discussion
Overall, around 95% of 76,471 motorcyclists observed used helmet (Figure 1). Reduction of obedience was observed with smaller roads or more distance with the city center (from arterial road to residential road) (Figure 2).

![Figure 1. Proportions of helmet usage by motorcyclist](image-url)
Female drivers dominated the residential roads while higher proportion of males was found on collective and arterial roads. Drivers with age less than 18 years old dominated residential and collective roads while drivers aged over 18 dominated the arterial roads (Figures 3 and 4).
The result showed strong evidence that type of road traversed and motorcyclist helmet usage obedience revealed to have a significant association. A pairwise z-test post hoc analysis with Bonferroni correction shows that there was a significant difference between numbers of motorcycle in all type of road traversed, \( p < .05 \). The effect size measured with Cramer’s V test in order to measure the association strength. This measure takes account both of degrees of freedom and sample size, also restricts the range of the statistics between 0 and 1 to be similar with correlation coefficient. The results for Cramer’s test lays between 0.21 and < 0.35 which means that the strength of association has a medium effect size.\[ \chi^2 (2, N=76.471) = 8978.759, p<0.01, V= 0.343. \] [15]

This research shows a good obedience of helmet usage motorcyclist in Bandung City. However, there were some drivers who still did not use helmet despite the fact that they have the highest risk of getting injured by traffic accidents. The risk was described in the number of patients who involved in traffic accidents in emergency unit and inpatient unit in Hasan Sadikin General Hospital (RSHS, Rumah Sakit Hasan Sadikin) in the past five years, which has been issued in the internal hospital report. Our observational study showed that the local type of road is the location with the highest number of disobediences. We could see that motorcyclist in local roads were more likely to be females and those who are under 18 years old. This could be a consideration to look for the reason for this condition, weather what gender and what age group we more likely to disobey the helmet usage. This might be because female ones are most likely to stay around their neighborhood, and have role as housewives, who take their kids to school, and are frightened to travel farther using motorcycle to bigger roads. Also, there is a law that motorcycle driving license must be owned by person above 16 years old.

Location and travel distance influence the type of the road traversed by motorcyclist, and influencing their obedience toward the helmet usage. The findings in our research is consistent with a study in Gujarat, India which found that obedience toward helmet usage among motorcyclist is higher on highways/main roads (97%) compared to inner City roads (87.2%).[16] A study in Mar Del Plata, Argentina in the year 2008 also shows that there was a 0.401 reduction in helmet usage in suburban area compared to City center area.[17] A study in Greece in the year 2012 investigating positive and negative factors in helmet usage shows that 9.3% participants argued that they did not need to use helmet since they were only travelling a short distance. [18] Similar result was found in a Greece study showing that among the motorcyclist using helmet, 9.7% used motorcycle on smaller roads, while on main roads/highways the proportion was 50.8%. Findings in these studies confirmed the association between levels of obedience with different types of road. [19] The number of properly used helmet (using the standardized helmet and locking the straps) was also lower in secondary roads.
in China.[20] Another study in Vietnam also shows that the use of helmet decreased in smaller roads.[21]

This research is observational; hence the accuracy of the observations was highly dependent on the surveyors’ interpretation in the field. Therefore, it is very possible to make mistakes in classifying the gender and age of the motorcyclist. This has been minimized by prioritizing data collection to vehicles with the closest visibility. However, this research has large number of samples, so it is considered that the errors have been minimized.

4. Conclusion

Improving road safety in urban conditions is significant to reduce the incidence of transportation accidents on the road, especially in the city centre. This can be prevented by improving the overall compliance of motorcyclist, both in the main and peripheral roads. The enforcement of regulations is mostly centered in the city centre, so more violations will occur in the suburbs. The tendency of female gender and age under 18 years old which dominate the local road types needs to be examined further. The other environmental conditions such as the presence of law enforcement, day and time of observation, weather, are needed to be considered for further research. This is important to promote road safety campaigns in the targeted population, also to gain more understanding of positive and negative factors toward obedience. This study strengthens the fact that improving regulation on road safety in smaller roads is crucial.

5. References

[1] World Health Organization 2015 Global Status Report on Road Safety 2015 (Geneva: World Health Organization)
[2] United Nations 2017 Road Safety - Considerations in Support of the 2030 Agenda for Sustainable Development United Nations Conference on Trade and Development (Geneva: United Nations)
[3] General Assembly 2004 Resolution adopted by the General Assembly A/RES/62/244 and A/66/389 First Global Ministerial Conference on Road Safety (Geneva: United Nations) [Available from: http://www.who.int/roadsafety/about/resolutions/download/en/]
[4] Indonesia Sample Registration System 2014 Deaths (Jakarta: Ministry of Health (Indonesia)) [Available from: http://www.depkes.go.id/]
[5] World Health Organization 2016 Road safety in the South East Asia region 2015 (New Delhi: World Health Organization)
[6] Road Traffic Corps, Police of Republic of Indonesia 2018 Traffic Accident Statistics (Statistik Laka) 2017-2018 (Jakarta: KORLANTAS POLRI) [Available from: http://korlantas.polri.go.id/]
[7] Bandung Health Department 2016 Profil Kesehatan Kota Bandung 2015 (Bandung: Departemen Kesehatan)
[8] Bandung Statistics 2016 Bandung Dalam Angka 2016 (Bandung: Badan Pusat Statistik Kota Bandung)
[9] Bandung Government 2017 Bandung Road Safety Annual Report 2015-2016 (Bandung: Pemerintah Kota Bandung)
[10] Khor D, Inaba K, Aiolfi A, Delapena S, Benjamin E, Matsushima K, Strumwasser A M and Demetriades D 2017 Injury. The impact of helmet use on outcomes after a motorcycle crash 48 1093-7
[11] Gupta S, Klaric K, Sam N, Din V, Juschkewitz T, Iv V, Shrive M G and Park K B 2018 Traffic Inj Prev. Impact of helmet use on traumatic brain injury from road traffic accidents in Cambodia 19 66-70
[12] Ha N T, Erderer D, Vo V A H, Pham A V, Mounts A, Nolen L D and Sugerman D 2016 Traffic Inj Prev. Changes in motorcycle-related injuries and deaths after mandatory motorcycle helmet law in a district of Vietnam 19 75-80
[13] Mohan D, Khayesi M, Tiwari G, Nafukho F M 2006 Road Traffic Injury Prevention Training Manual (Geneva: World Health Organization)

[14] Hyder A A, Paichadze N, Toroyan T, Peden M M 2017 Glob Public Health. Monitoring the decade of action for global road safety 2011–2020: an update 12 1492-505.

[15] F Andy 2013 Discovering Statistics Using SPSS C Michael SAGE 4th Edition 842-83

[16] Poonam M and Renuka G 2013 Proc. Int. Conf. Road safety on four continents: 16th international conference (Beijing) (Linköping: Statens väg- och transportforskningsinstitut)

[17] Ledesma R D, Peltzer R I. 2008 Rev Saude Publica. Helmet use among motorcyclists: observational study in the city of Mar del Plata, Argentina 42 143-5.

[18] Papadakaki M, Tzamalouka G, Orsi C, Kritikos A, Morandi A, Gnardellis C, Chliaoutakis J 2013 Transp Res Part F Traffic Psychol Behav. Barriers and facilitators of helmet use in a Greek sample of motorcycle riders: Which evidence? Transportation research part F: traffic psychology and behaviour 18 189-98.

[19] Skalkidou A, Petridou E, Papadopoulos F C, Dessypris N, Trichopoulos D. 1999 Inj Prev. Factors affecting motorcycle helmet use in the population of Greater Athens, Greece 5 264-7.

[20] Xuequn Y, Ke L, Ivers R , Du W, Senserrick T 2011 Accid Anal Prev. Prevalence rates of helmet use among motorcycle riders in a developed region in China 43 214-9.

[21] Hung D V, Stevenson M R, Ivers R Q 2006 Inj Prev. Prevalence of helmet use among motorcycle riders in Vietnam 12 409-13.

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