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HELMET USE COMPLIANCE SURVEY FOR CRANIOFACIAL TRAUMA PREVENTION AMONG MOTORCYCLISTS IN JAYAPURA CITY RING ROAD

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ABSTRACT

Introduction: Compliance with helmet use by motorcycle riders and passengers passing through the highway is one of the important factors in preventing craniofacial injuries and head injury. This study designed to survey and evaluate the compliance with helmet use among motorcyclists and passengers on the ring road in Jayapura City.
Methods: This time-based survey study observed compliance with helmet use by motorcycle riders and passengers passing through the Jayapura city ring road for 14 days of observation at three-time orders (morning, afternoon, and evening). Analysis of the collected data was carried out descriptively.
Results: The results showed that during the study period, there were 6,411 motorcycles passing through, 18,602 motorcycle passers-by were at moderate risk of injury due to not wearing helmets (MR-IV) and 11,849 were at high risk (HR-II). The peak of non-compliance with helmet use occurred in the afternoon period (T3). The results showed that 71.92% of the HR-V group did not obey helmet use; 184.82% of the HR-II group did not obey helmet use. While non-compliance with helmet use in the MR-IV group even reached 290.15%.
Conclusion: Helmet use compliance among motorcycle riders and passengers on the Jayapura Ring Road is low, increasing their risk of head injuries in accidents. This highlights the need for strategies to reduce helmet non-compliance in Jayapura City. The study focuses on one of the busiest routes, and further research is needed to assess helmet compliance on other busy routes in the city for a more comprehensive understanding.

Highlights:

1. This study provides insights on helmet compliance among motorcyclists in Jayapura City to help prevent head injuries.
2. The analysis shows non-compliance with helmets, especially on the Jayapura Ring Road, where up to four people ride a single motorbike.
3. Consequently, accidents causing head injuries result in greater health and humanitarian impacts.

INTRODUCTION

Currently, motorcycles have become the most common form of transportation in many developing countries, including Indonesia. Theoretically, road traffic accidents, especially those involving motorcycles, can usually be traced back to four main factors: driver negligence, vehicle issues, poor road conditions, and environmental factors.[1] The biggest contributor to head and facial injuries, including craniofacial injuries, is often driver negligence, particularly the failure to wear helmets.[2]

In relation to this, Many motorcyclists and passengers have various reasons for not wearing helmets, such as discomfort, poor visibility, heat, sweating, or simply feeling tired. [3]Other reasons include short trips (34.8%), not having a helmet (30.5%), and finding the helmet uncomfortable or disruptive (21.7%). Social and cultural attitudes also play a role, influencing how people perceive helmet use, and these factors need more attention in future research.[3]

According to the World Health Organization (WHO), road traffic accidents were responsible for 1.35 million deaths in 2018, and nearly 4,000 people die every day due to road accidents. Motorcycle-related injuries add to this global health burden, making traumatic brain injury (TBI) a leading cause of death and disability, especially in those under 45 years old.[5,6] Two-wheeled motor vehicle accidents cause humanitarian and economic problems. First, the humanitarian side shows that around two million people in the world die each year due to road traffic accidents; In contrast, the financial side shows that billions of rupiah have been spent due to traffic accidents for health financing.[7-11]

A study by Astride et al. (2018) found that 1,324 out of 2,108 traffic accidents treated at Dr. Hasan Sadikin General Hospital in Bandung were caused by riders not wearing helmets.[12] Law number 22 of 2009 (UU Nomor 22 tahun 2009) concerning traffic and road transportation in article 106 paragraph 8 requires every motorcycle driver and passenger to wear a helmet that meets Indonesian national standards.[1]

This study was conducted to obtain a picture of the behavior and compliance with the use of helmets among motorcycle drivers and passengers on the ring road, Jayapura City, Papua. The Jayapura city ring road is a straight track with a distance of about 3,200 meters, which was completed in 2018. Currently, this route is the most widely used route by motorcyclists in Jayapura City because it saves travel time for the same destination. This route has a straight track with very good asphalt performance, so it is preferred by motorcyclists. If motorcyclists are obedient in wearing helmets, the prediction of traumatic brain injury incidents including craniofacial injuries in motorcycle accidents will be at a low number.

Currently, there is no specific scientific research or survey that examines the compliance of motorcycle riders' helmet use in Jayapura. While so far in clinical practice as a neurosurgeon, many patients with head injuries treated were contributed by motorcycle riders who did not comply with wearing helmets while riding (Data not yet published). The contribution of cultural aspects and social behavior that play a role in non-compliance with helmet use does need to be studied further, however, this survey study at least provides an initial objective descriptive picture related to the behavior of helmet use by riders and passengers on the busiest routes in Jayapura City. This study will be an important basis for tightening the rules on mandatory helmet use for the Jayapura community, policy advocacy as well as the basis for information for various other studies that correlate helmet use with the risk of head injury, trauma to the body or the risk of other disabilities due to accidents in motorcycle riders. This study

focuses on data collection on compliance with helmet use among motorcyclists and passengers on the ring road in Jayapura City.

The results of this study can be used to develop educational programs on the use of standardized helmets, the identification of craniofacial injuries resulting from motorcycle accidents, and safe helmet removal techniques for motorcycle accident victims. Based on the data gathered from this study, a targeted program can then be designed, focusing on promotive, curative, and rehabilitative strategies related to craniofacial injury cases.

METHODS

This study is a time-based survey. Observations and recordings of motorcycles passing through the Jayapura Ring Road were conducted over 14 days, at three different times each day. These observations served as the research sample. There are no ethical concerns regarding the need for informed consent from the drivers or passengers observed in this study. Field enumerators, who were responsible for observing and counting the passing motorcycles, were trained to differentiate and classify them according to the criteria of LR-I, HR-II, MR-III, MR-IV, and HR-V. Based on the diagram Figure 1, the injury risk clusters were classified as follows: low-risk injury groups (LR) as Group I, medium-risk injury groups (MR) as Groups III and IV, and high-risk injury groups (HR) as Groups II and V.

The subjects of this study were motorcycle riders and/or passengers passing through the Jayapura City ring road (Figure 2) during the designated observation hours (Table 1). Observations and sampling were conducted at the research location over 14 consecutive days, from April to July 2024.

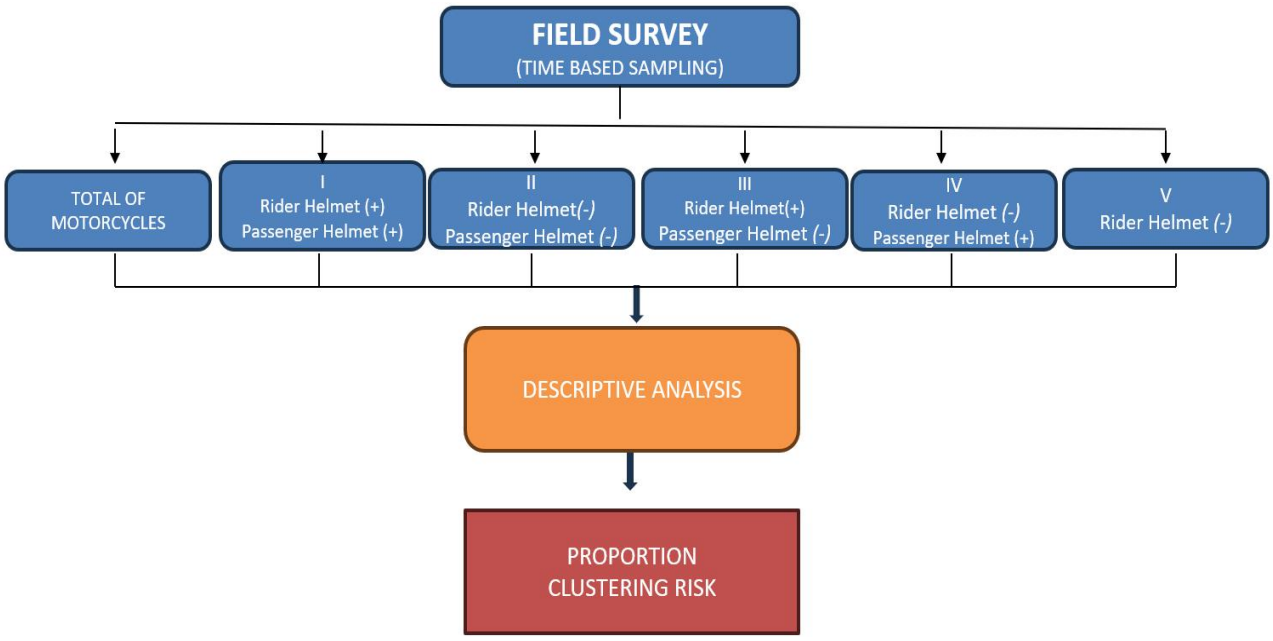


Figure 1. Observation Subject Classification Diagram

Figure 2. Aerial Photo of the 3.2 km Jayapura Ring Road

Table 1. Field Survey Observation Time Frame

Sampling Timing (WIT)	Explanation
07.30 – 09.00 (T1)	Peak time for people going to work (office, school, factory, etc.)
12.00 - 13.30 (T2)	Peak activity time during lunch hour or midday break
15.30 -17.00 (T3)	Peak time for people returning home

The inclusion criteria for this study were as follows: motorcycles passing through the ring road, with observations conducted by two enumerators according to a predetermined time frame based on estimated peak traffic density. These time frames included morning hours (when people are heading to work or school), daytime (during breaks), and evening hours (when returning from activities). Motorcycles passing through the observation point during the sampling hours were counted using a counter tool.

All data were tabulated, and the percentages of helmet use compliance by drivers, passengers, and both were calculated in relation to the total number of motorcycles passing by. The collected data were then analyzed into five risk clusters (low, medium, and high) for craniofacial injuries. The results will be presented in the form of tables, graphs, or diagrams.

RESULTS

The survey and observation for data collection were conducted over 14 consecutive days according to the time frame specified in Table 1. Based on Table 2, the total number of motorcycles passing during the observation period was 6,411. The data shows the number of motorcycles observed at different times of the day (T1, T2, T3) and breaks down the compliance across five risk groups (LR - Low Risk, MR - Medium Risk, HR - High Risk). The results of the observations revealed that one motorcycle could carry a rider accompanied by three or even four passengers, all of whom were not wearing helmets (Figures 3 & 4). Non-compliance with helmet use in the MR-IV group reached 290.16%, in HR-II it reached 184.82%, and in HR-V it reached 71.92%. The MR-IV group represents the scenario where the rider does not wear a helmet but the passenger does, while HR-II refers to the case where both the rider and the passenger are not wearing helmets. In contrast, the LR-I group showed relatively low non-compliance at 4.57%. These findings point to a concerning level of helmet use violations, particularly in high-risk groups. The observation did not include measurements of the motorcycle's speed while crossing the ring road, but the collected data provides important insights into the level of road users' compliance with traffic safety regulations. With a total of 7,229 motorcycles observed, the highest number of motorcycles were recorded during the afternoon/evening hours (T3), when people are returning home. The results underscore a serious issue with helmet use, especially in higher-risk groups, suggesting a need for increased road safety campaigns, stricter enforcement of helmet laws, and greater public awareness to reduce the risk of injuries, particularly craniofacial injuries. Therefore, more intensive efforts are needed to raise awareness and improve compliance with road safety rules.

Figure 3. Observations and Survey Recordings Show Drivers and Passengers Not Wearing Helmets

Figure 4. Observation and Recording of Motorcycle Surveys: Passengers Not Wearing Helmets

Table 2. Observation Results of the Helmet Compliance Survey on the Ring Road

Day		Jam	LR	MR		HR		Total Crossing	Amount According Time
			I	III	IV	II	V		
Wednesday	I	T_1	143	18	794	527	103	213	1,585
		T_2	360	21	740	645	150	150	1,916
		T_3	610	11	855	1,160	170	250	2,806
Thursday	II	T_1	165	1	1,010	405	71	1075	1,652
		T_2	60	6	355	150	109	75	680
		T_3	300	7	510	450	135	150	1,402
Friday	III	T_1	172	3	416	321	87	153	999
		T_2	150	4	235	250	163	120	802
		T_3	240	14	550	360	120	185	1,284
Saturday	IV	T_1	135	2	468	240	59	150	904
		T_2	350	4	384	270	94	175	1,102
		T_3	475	3	422	345	137	220	1,382
Sunday	V	T_1	95	6	265	152	90	54	608
		T_2	354	26	395	450	143	196	1,368
		T_3	368	6	265	427	90	184	1,156
Monday	VI	T_1	93	2	200	191	75	67	561
		T_2	161	15	290	300	110	125	876
		T_3	373	10	450	476	295	201	1,604
Tuesday	VII	T_1	59	0	384	141	36	62	620
		T_2	139	1	340	249	96	120	825
		T_3	218	2	458	325	100	184	1,103
Wednesday	VIII	T_1	39	5	345	113	43	59	545
		T_2	78	10	410	197	97	118	792

Day		Jam	LR	MR		HR		Total Crossing	Amount According Time
			I	III	IV	II	V		
		T_3	189	19	663	317	233	191	1,421
Thursday	IX	T_1	83	2	389	459	121	114	1,054
		T_2	75	5	300	164	69	63	613
		T_3	178	10	484	171	101	159	944
Friday	X	T_1	70	8	230	102	73	109	483
		T_2	193	2	534	309	114	185	1,152
		T_3	208	0	609	342	334	140	1,493
Saturday	XI	T_1	28	1	730	124	85	88	968
		T_2	56	1	384	117	67	70	625
		T_3	196	13	659	274	137	122	1279
Sunday	XII	T_1	15	5	515	100	37	73	672
		T_2	52	6	280	105	71	58	514
		T_3	121	11	445	179	105	103	861
Monday	XIII	T_1	25	2	132	125	81	126	365
		T_2	86	6	409	191	59	93	751
		T_3	154	6	197	271	129	145	757
Tuesday	XIV	T_1	36	3	555	127	38	77	759
		T_2	89	4	420	104	76	91	693
		T_3	238	12	126	124	108	118	608
Grand Total			7,229	293	18,602	11,849	4,611	6,411	
Percentage of Non-compliance with helmet use				4.57%	290.16%	184.82%	71.92%		

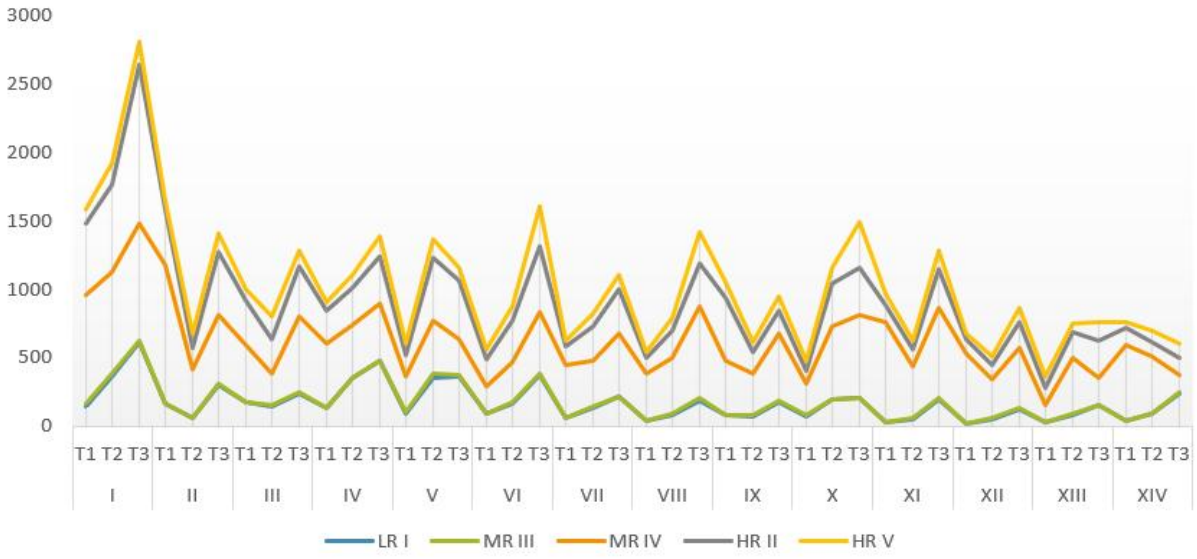
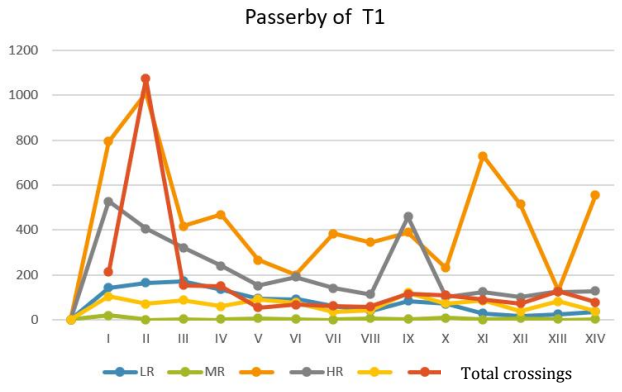


Figure 5. Helmet Compliance Graph on the Ring Road Route

The number of motorcyclists in Group IV (18,602) and Group II (11,849) represents the highest figures during the field observation period. When these two groups are combined, it is clear that most of the motorcyclists passing through the ring road are riders without helmets (Figure 5). This indicates that helmet use compliance among motorcycle riders is very low. Additionally, the HR passers-by in Group II (riders and passengers without helmets) reached the highest number (1,160), which is even four times the total number of motorcycles passing (250 motorcycles). This suggests that one motorcycle is ridden by at least four people, all of whom are not wearing helmets (see Table 2, Day I, T3).

When analyzing helmet use compliance according to the time of passage, it can be seen that the MR-IV group dominates throughout the observation period (Figure 6). This means that motorcyclists on this route are mainly from groups where the rider is not wearing a helmet but the passenger is. The proportion of motorcyclists passing through the ring road is highest during the T3 time period, which corresponds to the hours after work (15:30-17:00 WIT), as shown in the following graph (Figure 7).



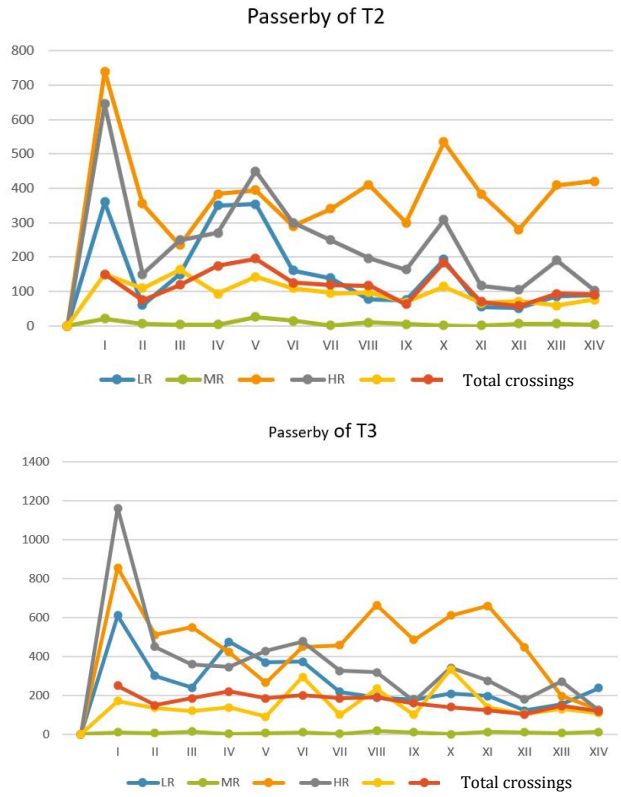


Figure 6. Graphof Compliance with Wearing a Helmet According to The Crossing Time Order

Figure 7. Dominance of Time Order of Motorcycles Crossing the Jayapura Ring Road

Further analysis reveals that the behavior of motorcyclists during the observation period is dominated by the MR-IV and HR-II groups. At T1, the MR-IV group has a median value of 459.5, with a whisker of 1,010; at T2, the HR-II group has a median value of 250.07, with a whisker of 450; and at T3, the MR-IV group has a median value of 478.07, with a whisker of 855 (Figure 8). This pattern highlights that the highest incidence of non-compliance occurs during peak travel times, particularly in the afternoon when traffic is heavier. The data suggests a consistent trend of risky behavior, where a significant number of riders neglect helmet use despite the presence of passengers who may be wearing helmets. This raises concerns about the effectiveness of safety campaigns targeting helmet use, as well as the need for stricter enforcement of traffic safety regulations, especially during peak hours when the risk of accidents is higher.

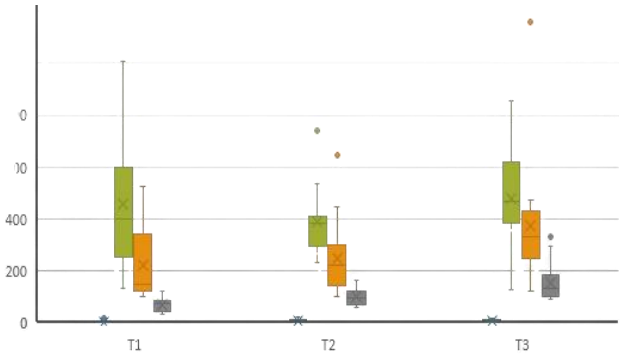


Figure 8. Box Plot of Risk According to Time Order in The MR And HR Groups.

The risk of injury is higher in the MR-IV group, particularly for riders without helmets and passengers wearing helmets, during the T1 observation time (07:30–09:00 WIT), which coincides with the peak of morning activity (when people are heading to work or school). A similarly high risk was observed in the MR-IV group during the T3 observation time (15:30–17:00 WIT), when people are returning home from work, school, or other activities. The results of this survey provide only descriptive data on non-compliance with helmet use in at-risk groups. In the event of an accident, these groups would be more likely to experience head injuries. One limitation of this study is that it did not analyze the relationship between vehicle speed, non-compliance with helmet use, and the risk of head injuries, including their severity, type, and other factors. Further research could explore these connections in greater detail.

DISCUSSION

Non-compliance with wearing helmets puts motorcyclists and passengers who cross the Jayapura City ring road at risk of head injury and craniofacial injuries. In Undang-Undang RI No 22/2009 concerning road traffic and transportation, drivers and passengers are required to wear helmets as standardized personal protective equipment.[1] There are several reasons for non-compliance with wearing helmets, such as short distances, no one supervising (police), troublesome, uncomfortable or imitating other people's habits, or not having a helmet.[6,10,13] In fact, according to the results of this study, the highest mobility on the observation route was crossed by the MR-IV group (18,602) and HR-II (11,849). In these groups, non-compliance with helmet use reached 290.16% and 184.82% respectively. Uniquely, in both groups, all motorcyclists did not comply with wearing helmets. The highest mobilization on the route was during the T3 time period (15.30-17.00) in the afternoon. In this survey, there was no in-depth observation of the reasons for non-compliance with helmet use, although the study revealed that the reason for non-compliance with helmet use was due to not having a helmet.[6,14,15] In general, according to the results of this study, motorcycle passers-by showed that in the T1 time order, non-compliance with helmet use was very low; this can happen because usually in the

morning there are still many traffic police officers who supervise crucial road points on the ring road route. This study has not yet linked non-compliance with helmet use on the observation route and the risk (number and type) of craniofacial injuries that occurred during the observation period and the speed of the passing motorcycle. In fact, data shows that head injuries with the highest death and disability rates occur in motorcycle accidents where the riders do not wear helmets.[16-20] This study also has several limitations, including when the survey was conducted, it was not observed regarding gender (male or female), age limits (children, young adults, or the elderly), and the profession of two-wheeled vehicle users who passed on the observed route. Likewise, the various reasons for motorcycle users related to why they did not wear helmets were not analyzed. This study also did not detail the types of head injuries recorded and were part of the number of motorcycle accidents that occurred during the survey period and also did not specifically classify the types of motorcycles whose riders were obedient or disobedient.[6,16,17]

Head injury is an injury that includes trauma to the scalp, skull, and brain. Head injury can result in very serious neurological disorders. Head injury is a major cause of disability and death, especially in young adults. In the United States, almost 10% of deaths are caused by trauma, and half of all deaths from trauma are related to the brain. A head injury case occurs every 7 seconds and a death from head injury occurs every 5 minutes. Head injury can occur in all age groups, but the highest incidence is in young adults aged 15-24 years. The incidence in men is 3 to 4 times more often than in women.[19,21] The cause of head injury in Indonesia is mostly due to traffic accidents that can be reported only for land transportation, there appears to be a fairly high increase of 47.7% to 64.2%.[24] The main types of injuries in motorcycle accidents are traumatic brain injuries (cranium) and facial injuries (facial area). Both conditions are very serious because they will cause various symptoms such as decreased consciousness, seizures, lacerations of the head structure, to other more severe intracranial damage.[6,12,13,21] More than 50% of head and facial damage is caused by trauma mechanisms and failure of the helmet's protective function. A motorcyclist must wear a standard helmet to avoid craniofacial damage. Craniofacial injuries caused by motorcycle accidents in riders without helmets will have an impact on the severity of craniofacial injury complications. The severity in question can consist of death (30-36%), persistent vegetative conditions (5%), severe disability (15%), moderate disability (15-20%), and unsatisfactory recovery reaching 60%.[2,6,12] Other sequelae due to craniofacial injuries include persistent psychological and behavioral disorders.[18-19]

The program to promote the use of helmets for motorcyclists needs to be improved, especially for people using the ring road in Jayapura City. The program can be carried out in an integrated and comprehensive manner.[20-23] Involving positive influences and the role of several figures (athletes, artists, religious figures, etc.) so as to increase behavioral changes, especially in the younger generation who often use motorbikes as a means of transportation. Likewise, special programs need to be carried out by professional health workers for preventive measures against head injuries due to compliance with helmet use, starting from primary to tertiary health facilities.[6,10,13]

To increase helmet use awareness, it is crucial to implement a multifaceted approach that targets different community sectors and emphasizes the severity of craniofacial injuries. Specific campaigns could include educational initiatives in schools, workplaces, and local communities, focusing on the importance of helmet use for preventing head and facial trauma. Public service announcements, social media campaigns, and television ads could feature medical professionals, community leaders, and

popular figures such as athletes and celebrities to amplify the message. These campaigns should address not only the health risks associated with not wearing a helmet but also the cultural and behavioral barriers that contribute to non-compliance.

In addition, healthcare professionals, including doctors, nurses, and emergency responders, should be involved in promoting helmet use. Medical staff can provide educational materials to patients and their families, emphasizing the importance of helmets in preventing severe injuries. Specialized training programs for healthcare workers should also be established to improve their skills in identifying and managing craniofacial injuries resulting from motorcycle accidents. These programs could be incorporated into medical education curricula and ongoing professional development.

Local government agencies, traffic police, and non-governmental organizations (NGOs) focused on road safety should collaborate with healthcare providers to create comprehensive campaigns that reinforce the legal and health consequences of not wearing a helmet. Community events, such as road safety workshops or helmet distribution programs, could further engage the public and encourage behavioral change. By combining these efforts, a holistic strategy for promoting helmet use can be developed, leading to a significant reduction in craniofacial injuries and improving overall road safety.

Promotion of the use of standardized helmets to training on how to remove helmets from accident victims needs to be carried out. According to the recommendations of the Global Road Safety Partnership and the World Bank Group, there is a type of helmet that is highly recommended for motorcyclists, namely a full-face helmet. This type of helmet is the safest helmet for motorcyclists to use. The advantage is that it can protect the face, head, neck, ears, and chin perfectly; it is also safe to wear in the rain and protects the user from dust, gravel, or insects on the road. This type of helmet can protect the user from unwanted injuries during an accident. The disadvantage is that because it is tightly closed, the user has difficulty hearing the sounds around him, and it is impractical if the user wants to eat or drink in the middle of the road. For glasses users, this type of helmet is very uncomfortable to wear and the price is relatively more expensive than other types.[4]

This study is both strong and novel in its approach to understanding helmet use compliance among motorcyclists in Jayapura, an area where no prior research has been conducted on this topic. The strength of the study lies in its real-world data collection, spanning 14 days with multiple observations at different times of the day, providing a comprehensive view of motorcyclist behavior in natural settings. Additionally, by categorizing helmet use compliance into five risk clusters, the study offers a detailed analysis of when and where non-compliance is most prevalent, which can inform targeted interventions. The novelty of this research is evident in its focus on a previously unexamined population in Jayapura, filling a significant gap in local public health data. Moreover, the study highlights the cultural and social factors influencing helmet use, opening the door for future research into how these aspects impact safety behavior. This research is not only pivotal in guiding local policy changes but also offers valuable insights for broader public health initiatives aimed at reducing head and craniofacial injuries caused by motorcycle accidents.

This study is limited to surveying motorcycles passing through the ring road. Similar survey observations can be conducted at several crucial points of the route passed by motorcycle riders in Jayapura City.

Further research can be conducted to link several interesting things such as the relationship between non-compliance with helmet use, the degree of head injury, the type of helmet used, aspects of health costs

due to head injuries to various interesting demographic aspects (for example age group, gender, basic reasons for not using a helmet, etc.)

CONCLUSION

The highest helmet non-compliance was in the MR-IV group (riders without helmets, passengers wearing helmets) and occurred in all-time orders every day; although the highest peak occurred in the T3 time order. Helmet compliance occurred in the LR-I group and the lowest in MR-III in general in the T1 time order. This helmet non-compliance puts motorcycle riders and passengers who cross the Jayapura ring road at risk of head and craniofacial injuries when an accident occurs. Based on the results of this study, more massive and targeted helmet promotion efforts are needed to further reduce the number of helmet non-compliance among motorcycle users in Jayapura City. The findings of this study can be a driving force for tightening the rules on helmet use for motorcyclists in Jayapura City. Likewise, it is a fact to increase education on helmet use, especially among students and workers who use motorbikes in Jayapura City. In addition, potential research is needed related to efforts to prevent traumatic brain injury in motorcycle riders by increasing helmet compliance.

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CONFLICT OF INTEREST

All authors declare that no conflicts of interest regarding the publication of this article.

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AUTHOR CONTRIBUTION

Data collection, analysis, inpretation of the results and preparing the manuscript unrtaken of all authors.

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