RISKY BEHAVIOURS AMONG DELIVERY RIDERS AT SIGNALIZED INTERSECTIONS IN MALAYSIA

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Abstract

The increasing number of food delivery riders, known as P-hailing riders, has increased the number of traffic crashes involving this group. The high demand for online orders and delivery time constraints causes the delivery riders to engage in risky riding behaviours during delivery. Thus, there is a need to study this alarming problem before it becomes more serious. This study aims to determine factors influencing risky behaviours among delivery riders at signalized intersections. A roadside observation was conducted in the month of October 2022 at Subang Jaya, Selangor. A total of 19,803 delivery riders were observed for four days observations at two signalized T- and two cross-signalized intersections. A bivariate analysis (logistic regression) was applied to determine the relationship between seven risky behaviours (unfastened helmet, not wearing shoes, incomplete set of side mirrors, red light running, mobile phone use, stopping after stop lines, and abrupt lane change) with five explanatory variables including the day of the week, time of the day, weather condition, type of intersection and approach road. The result shows that red light running, and mobile phone use is more likely to occur during the weekend. Clear weather increases risky behaviours such as red light running, using a mobile phone, and abrupt lane changes. The findings of this study are useful as input to the related authorities in developing programs to decrease the number of crashes involving food delivery riders.

Keywords: Risky Behaviour, Delivery Riders, Traffic Crashes, Motorcycle, P-Hailing

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INTRODUCTION

Electronic commerce, or known as e-commerce, is the process of buying and selling goods and services or transmitting funds or data through an electronic network, most commonly the Internet. Over the past ten years, e-commerce has expanded significantly as many consumers have shifted to online shopping. The main factors creating this trend include the customer's disposable income increasing, electronic payments becoming more secure, and the range of suppliers and the size of their delivery networks expanding (Li et al., 2020). Statistics from Global Data show that the e-commerce sector in Malaysia will increase by 19.9% to USD 9.2 billion in 2022, which is supported by a fast-expanding shift from offline to online shopping (GlobalData, 2022). Malaysia also was identified among the fastest-growing e-commerce markets in Southeast Asia (Dong, 2022). The growth is supported by the rapid adoption of smartphones, growing internet usage, and the availability of safe online payment systems. In addition, due to the rapid growth of e-commerce, specialization delivery services are important for delivering goods to consumers.

One of the most popular delivery services nowadays is P-Hailing services. P-Hailing refers to the delivery of parcels, food, or documents using motorcycles. In Malaysia, many food service providers offer food delivery services to customers, including Food Panda, DeliverEat, Uber Eats, Grab Food, Lalamove, Honestbee, and Running Man Delivery (Rusli et al., 2022). Food Panda and Grab are among the well-known food delivery service providers and are regularly used by customers to order and deliver their food (Nayan & Hassan, 2020).

The COVID-19 pandemic has had some impact on the business environment around the globe. A study by Sapian et al. (2022) in Malaysia identified the Movement Control Order (enforced Malaysian Government during the COVID-19 pandemic) has a substantial impact on commercial activities. Among the industries growth during this pandemic period is food delivery service. Consumers are more likely to choose to take away food in conjunction with the standard government practice during the COVID-19 pandemic (Nayan & Hassan, 2020). The demand for food delivery has tremendously increased, especially since the Malaysian Government announced a lockdown in response to the COVID-19 pandemic (Rahim & Yunus, 2021). During the COVID-19 pandemic period, food delivery services become more trending when it is allowed to operate as it falls under essential services. In addition, the spread of the COVID-19 pandemic also causes many people to have been laid off and choose to work as food delivery riders (The Star, 2021).

The increase in the number of food delivery riders and demand for food delivery services increased the number of road traffic crashes involving this group. Statistics from the Royal Malaysian Police reveal that a total number of 321 road traffic crashes involving delivery riders were reported, with 36 accidents

resulting in fatalities between January 2020 and August 2020 (Samuel, 2021). In Kuala Lumpur, 1,242 road traffic crashes involving food delivery drivers were reported from 2018 to May 2021 (Carvalho et al., 2022). Out of these, 1,048 cases cause light injuries, 82 cases cause serious injuries, and 112 cases cause deaths. Fauzi et al. (2022) reveal 17 fatalities, 10 serious injuries, and 64 minor injuries were reported among P-Hailing riders while on delivery runs in Malaysia during various stages of lockdown during the COVID-19 pandemic where the figure is constantly growing for these reasons.

This study aims to investigate food delivery riders' behavioural issues at signalized intersections in Malaysia. Seven risky behaviours were targeted: unfastened helmet, not wearing shoes, incomplete set of side mirrors, red light running, mobile phone use, stopping after stop lines, and abrupt lane change. A study by Sultan et al. (2016) targeting young motorcyclists in Malaysia found human attitude is one of the main factors that cause motorcycle crashes. The results from this study could help related authorities prepare safety programs focusing on food delivery riders.

RESEARCH METHODOLOGY
Study Setting
The site observation for this study was conducted in the month of October 2022 at four signalized intersections in Subang Jaya. Subang Jaya is the sixth largest city in Malaysia, with a population of approximately 968,930 people in 2020 (Urbanice Malaysia, 2021).

Data Collection
Data were collected at the approach's intersections by the appointed two enumerators at each intersection and supervised by the authors. Enumerators were positioned at locations that were not visible to the riders. This is important to ensure their presence was not influencing the rider's behaviours. The seven risky behaviours observed during this process include an unfastened helmet, not wearing shoes, incomplete set of side mirrors, red light running, mobile phone use, stopping after the stop line, and abrupt lane change. The contextual characteristics included the day of the week (weekdays or weekends), time of the day (peak or non-peak hours), weather conditions (clear or rain), type of intersections (cross junction or T-junction), the approach of delivery riders to the intersection (from a major or minor road). Gender has been dropped from the list of variables due to no observation has been made during the observation period.

The data collection process was held for seven hours a day on two days, weekdays (Monday and Wednesday) and two days weekends (Saturday and Sunday). Data was collected at peak hours from 11.00 AM to 1.00 PM and 5.00 PM to 7.00 PM, whereas for non-peak hours from 10.00 AM to 11.00 AM and

3.00 PM to 5.00 PM. Data was collected from those delivery riders who crossed the intersections using the manual method.

Data Analysis

A binary logistic regression model was adopted in this study to explore factors influencing seven risky behaviour (unfastened helmet, not wearing shoes, incomplete set of side mirrors, red light running, mobile phone use, stopping after stop line, and abrupt lane change) in regards to five explanatory variables (day of the week, time of the day, weather condition, type of intersections and approach road). The coefficient of determination, Cox and Snell's R^2, and Nagelkerke's R^2 have been calculated to measure the appropriateness of the regression models (Rusli et al., 2020). All data analysis process was conducted using the Statistical Package for Social Science (SPSS) Version 20.

RESULTS

Descriptive Statistics

A total of 19,803 food delivery riders were observed throughout the observation period. All of them were male and observed wearing a helmet. It is found that about 8,733 (44.1%) riders stopped after the stop line, 6,403 (32.3%) were found not wearing proper shoes during delivery, 2,118 (10.7%) were involved in red light running, 545 (2.8%) were recorded for use a mobile phone, 198 (1.0%) of riders observed perform an abrupt lane change, 110 (0.6%) were recorded had an incomplete set of side mirrors either left or right, and 73 (0.4%) were observed unfastened their helmet.

Out of 19,803 food delivery riders observed, 10,865 of them were observed at the cross junction, and 8,938 were observed at the T-junction. A greater percentage of riders were observed at peak hours (54.1%), during clear weather (66.0%), on weekdays (74.0%), and approaching from a major road (74.9%).

Logistics Regression for Risky Behaviour

To examine the relationship between risky behaviours and explanatory variables, seven binary regressions were developed for each of the risky behaviours. Further sub-sections have presented the results of binary regression for each risky riding behaviours. Table 3 presented the risky riding behaviours among food delivery riders at signalized intersections by explanatory variables. Table 4 shows the model estimation for seven risky riding behaviours among this type of rider at signalized intersections.

Modeling results show that the value for Cox & Snell R^2 is 2% and 36% for Nagelkerke R^2, indicating the amount of variance explained by the unfastened helmet. Junction type has been found as only one of the variables statistically significant in this model (OR: 3.323, p < .001, 95% CI: 1.931-5.719). However,

the other variables are found not statistically significant in influencing the unfastened helmet behaviour. The odds ratio for the unfastened helmet is 3.3 times higher at the T-junction compared to the cross junction.

The model predicting not wearing shoes was significant (Cox & Snell R^2 =2.5%, Nagelkerke R^2= 3.5%). The intersections type also only the variables associated with this risky behaviour (OR: 0.485, p < .001, 95% CI: 0.453-0.520). The other variables are found not to be significantly influencing not wearing shoe behaviours. The odds ratio of not wearing shoes decreased by 0.485 times at the T-junction compared to the cross-junction.

The model shows that there are no variables found statistically significant for having an incomplete set of side mirrors. Even though the results show insignificant value, the traffic crash might be happened due to a human blind spot. The side mirrors are required for viewing objects from the sides and rear.

The value for Cox & Snell R^2 and Nagelkerke R^2 is 0.3% and 0.6%, respectively. There are four variables that influenced the red light running, which is the day of the week (OR: 1.132, p < .05, 95% CI: 1.014-1.264), weather (OR: 0.830, p < .001, 95% CI: 0.740-0.930), type of intersections (OR: 1.331, p < .001, 95% CI: 1.203-1.472) and type of approach road (OR: 0.766, p < .001, 95% CI: 0.686-0.856). The odd ratio to red light running increased 1.3 times at T-junction and 1.1 times during the weekend. However, the odds decreased 0.830 times during the rainy day and 0.766 times lower for riders approaching from the minor road.

The model has predicting mobile phone use was significant to three variables, including the day of the week (OR: 1.293, p < .05, 95% CI: 1.057-1.581), weather (OR: 0.741, p < .01, 95% CI: 0.594-0.925) and type of approach road (OR: 0.683, p < .001, 95% CI: 0.551-0.848). The value for Cox & Snell R^2 is 0.1% and 0.6% for Nagelkerke R^2. The analysis on an odds ratio of mobile phone use shows a significant increase in risky behaviour with respect to the day of the week (p<0.05). The odds ratio increased by 1.293 times higher during the weekend compared to weekdays, slightly less by 0.741 times during rainy days, and 0.683 times lower for riders approaching from the minor road.

The model explained risky behaviour for stopping after the stop line was significant, with 3.5% and 4.8% for Cox & Snell R^2 and Nagelkerke R^2 values, respectively. Time of the day (OR: 0.927, p < .01, 95% CI: 0.875-0.981) and type of intersections (OR: 0.457, p < .001, 95% CI: 0.428-0.487) were significant variables associated with this risky behaviour. The odds ratio slightly decreased by 0.927 times during non-peak hours and 0.457 times lower at T-junction.

Finally, logistic regression was undertaken to determine the associations between risky behaviour for abrupt lane change with three significant variables, which are the day of the week (OR: 0.661, p < .05, 95% CI:

0.463-0.945), weather (OR: 1.572, p < .01, 95% CI: 1.121-2.205) and type of intersections (OR: 0.304, p < .001, 95% CI: 0.212-0.435). The value for Cox & Snell R^2 is 0.3% and 2.7% for Nagelkerke R^2. The odds ratio increased by 1.572 times higher during clear weather compared to rainy conditions, slightly less by 0.661 times during weekends, and 0.304 times lower at T-junction.

DISCUSSION

The influencing factors of seven risky behaviour among food delivery riders are investigated in this study (i.e., unfastened helmet, not wearing shoes, incomplete set of side mirrors, red light running, mobile phone use, stopping after stop line, and abrupt lane change). Association with explanatory variables was examined, including the day of the week, time of the day, weather conditions, type of intersections, and approach road. The results showed that there are explanatory variables found associated with risky riding behaviours except for the incomplete set of side mirrors model, where there are no explanatory variables found statistically significant.

Out of seven risky riding behaviours observed, the highest recorded is stopping after the stop lane. The second highest risky riding behaviours observed in this study is not wearing proper shoes during delivery. Then, red light running becomes the third risky riding behaviours the food delivery riders perform. Based on statistics from the Road Transport Department Malaysia, during Ops Merah 2021 operation between 8th October to 6th November, the highest offense involving food delivery riders was violating red light signals with 902 offenses (The Star, 2021a). Mobile phone use and abrupt lane changes are the four and fifth risky riding behaviours observed in this study. Incomplete side mirrors for both sides become the next risky riding behaviours observed in this group of riders. The enforcement of motorcycles to install complete side mirrors shows success. This study found that only a minority of food delivery riders observed have not complete side mirrors for both sides. Lastly, the unfastened helmet is the lowest risky riding behaviours observed in this study. Even though this risky behaviour is not discussed seriously among the researcher, the impact of unfastened helmet straps is quite serious. A study by Arif et al. (2019) revealed the number of injuries was significantly higher in the unfastened helmet group as compared with fastened helmet group.

Table 3: Descriptive analysis of risky riding behaviours by explanatory variables

Variable	Fastened helmet		Wearing shoes		Complete set of side mirrors		Red light running		Mobile phone use		Stopping after the stop line		Abrupt lane change	
	Yes (%)	No (%)	Yes (%)	No (%)	Yes (%)	No (%)	Yes (%)	No (%)	Yes (%)	No (%)	Yes (%)	No (%)	Yes (%)	No (%)
Day of week														
Weekdays	14594(99.6)	59(0.4)	9856(67.3)	4797(32.7)	14575(99.5)	78(0.5)	1546(10.6)	13107(89.4)	393(2.7)	14260(97.3)	6487(44.3)	8166(55.7)	158(1.1)	14495(98.9)
Weekend	5136(99.7)	14(0.3)	3544(68.8)	1606(31.2)	5118(99.4)	320(0.6)	574(11.1)	4576(88.9)	161(3.1)	4989(96.9)	2242(43.5)	2908(56.5)	41(0.8)	5109(99.2)
Time of day														
Peak hours	10677(99.7)	28(0.3)	7212(67.4)	3493(32.6)	10644(99.4)	61(0.6)	1111(10.4)	9594(89.6)	287(2.7)	10418(97.3)	4812(45.0)	5893(55.0)	96(0.9)	10609(99.1)
Non-peak hours	9053(99.5)	45(0.5)	6188(68.0)	2910(32.0)	9049(99.5)	49(0.5)	1009(11.1)	8089(88.9)	267(2.9)	8831(97.1)	3917(43.1)	5181(56.9)	103(1.1)	8995(98.9)
Weather														
Clear	13028(99.6)	47(0.4)	8583(65.6)	4492(34.4)	13000(99.4)	75(0.6)	1410(10.8)	11665(89.2)	392(3.0)	12683(97.0)	6122(46.8)	6953(53.2)	138(1.1)	12937(98.9)
Rain	6702(99.6)	26(0.4)	4817(71.6)	1911(28.4)	6693(99.5)	35(0.5)	710(10.6)	6018(89.4)	162(2.4)	6556(97.6)	2607(38.7)	4121(61.3)	61(0.9)	6667(99.1)
Type of Intersections														
Cross junction	10844(99.8)	21(0.2)	6624(61.0)	4241(39.0)	10813(99.5)	52(0.5)	1062(9.8)	9803(90.2)	320(2.9)	10545(97.1)	5708(52.5)	5157(47.5)	153(1.4)	10712(98.6)
T-junction	8886(99.4)	52(0.6)	6776(75.8)	2162(24.2)	8880(99.4)	58(0.6)	1058(11.8)	7880(88.2)	234(2.6)	8704(97.4)	3021(33.8)	5917(66.2)	46(0.5)	8892(99.5)
Approach														
Major	14772(99.6)	61(0.4)	10035(67.7)	4798(32.3)	14744(99.4)	89(0.6)	1679(11.3)	13154(88.7)	450(3.0)	14383(97.0)	6573(44.3)	8260(55.7)	158(1.1)	14675(98.9)
Minor	4958(99.8)	12(0.2)	3365(67.7)	1605(32.3)	4949(99.6)	21(0.4)	441(8.9)	4529(91.1)	104(2.1)	4866(97.9)	2156(43.4)	2814(56.6)	41(0.8)	4929(99.2)

Table 4: Logistic regression results for risky behaviour among delivery riders at the signalized intersection

Variable	Reference category	Unfastened helmet		Not wearing shoes		Incomplete set of side mirrors		Red light running		Mobile phone use		Stopping after stop lines		Abrupt lane change	
		Odds Ratio	Confidence Interval (95%)	Odds Ratio	Confidence Interval (95%)	Odds Ratio	Confidence Interval (95%)	Odds Ratio	Confidence Interval (95%)	Odds Ratio	Confidence Interval (95%)	Odds Ratio	Confidence Interval (95%)	Odds Ratio	Confidence Interval(95%)
Day of week															
Weekend	Weekdays	0.741	0.386-1.421	0.917	0.852-0.987	1.364	0.863-2.157	1.132*	1.014-1.264	1.293*	1.057-1.581	0.972	0.907-1.042	0.661*	0.463-0.945
Time of day															
Non-peak hours	Peak hours	1.919	1.194-3.084	0.974	0.917-1.035	0.939	0.644-1.370	1.078	0.985-1.180	1.096	0.926-1.299	0.927**	0.875-0.981	1.294	0.978-1.712
Weather															
Rain	Clear	0.769	0.437-1.354	1.070	0.992-1.154	0.663	0.406-1.082	0.830***	0.740-0.930	0.741**	0.594-0.925	1.022	0.951-1.098	1.572***	1.121-.205
Type of Intersections															
T-junction	Cross junction	3.323***	1.931-5.719	0.485***	0.453-0.520	1.594	1.045-2.432	1.331***	1.203-1.472	0.994	0.802-1.204	0.457***	0.428-0.487	0.304***	0.212-0.435
Approach Road															
Minor	Major	0.573	0.308-1.067	0.985	0.919-1.056	0.715	0.444-1.153	0.766***	0.686-0.856	0.683***	0.551-0.848	0.951	0.890-1.016	0.751	0.532-1.061
Constant		0.002***		0.658***		0.005***		0.111***		0.031***		1.166***		0.014***	
Log likelihood		929.565		24417.516		1353.786		13418.485		5028.795		26459.160		2169.826	
Cox & Snell R²		0.02		0.025		0.00		0.003		0.001		0.035		0.003	
Nagelkerke R²		0.36		0.035		0.006		0.006		0.006		0.048		0.027	

* p < 0.05
** p < 0.01
*** p < 0.001

The present study found that red light running, and mobile phone users are more likely to occur during a weekend delivery. An observation study by Rusli et al. (2020) on motorcyclists in Kuala Terengganu, Malaysia, found helmet non-use and turn signal neglect are more frequent on weekends than on weekdays. They explain that less traffic volume might be the reason behind this observation. Another possible explanation for this is also due to the higher demand for delivery during weekends compared to weekdays. Hirschberg et al. (2016) reveal that most orders placed through online platforms were on weekends, accounting for 74% of all orders compared to weekdays. A study in Germany by Heiland (2021) also found weekend evenings among the time when online order exceeds the supply of riders. Byun et al. (2020) also found food delivery in the Republic of Korea is usually higher during the weekend than on weekdays. However, there is no study in Malaysia to compare the number of food delivery orders between weekends and weekdays. On the other hand, abrupt lane change is less likely to happen during weekends compared to weekdays. This also might be due to less traffic volume during the weekend, decreasing the abrupt lane change behaviours among the riders.

Stopping after the stop line behaviour was found to decrease during non-peak hours compared to peak hours. This finding is in line with previous research by Chen et al. (2015). They found early-start manoeuvres among motorcyclists in Taiwan more likely to increase during off-peak hours. However, a study conducted by Rusli & Salam (2021) among motorcyclists in Kuala Terengganu, Malaysia, found there is no statistically significant difference between weekdays and weekends regarding stopping after stop-line behaviours. This shows the difference in riding behaviours among food delivery riders and general motorcyclists. However, these finding merits further discussion and exploration due to contrary evidence.

The present study found that food delivery riders are less likely to engage in red light running and mobile phone use during rainy conditions. This might be a result of the food delivery riders being more cautious in bad weather, such as rain. Riders who deliver food are more likely to use self-control or risk-compensating techniques when it's raining. Papakostopoulos & Nathanael (2021) discover that weather conditions are among the main concern of food delivery riders during work in Athens, Greece. A study among motorcycle couriers in the Republic of Korea also identified that the rate of traffic violations during rain or snow is less (3.9%) compared to clear weather (12.0%) (Shin et al., 2019). A study by Faria et al. (2020) explained that average driving speeds were found to drop by 22% and 13% during heavy and light precipitation, respectively, suggesting a change in driving behaviour and patterns. This finding is also consistent with the acceleration change, with average positive and negative acceleration dropping by 8% and 11%, respectively. Additionally, the percentage of time spent on hard braking or hard acceleration is also less compared to dry

weather (Bakhshi et al., 2022). On the other hand, abrupt lane change behaviours were found to increase during rainy conditions. Waiting at the front of the queue at a signalized intersection might be one of the possible explanations for this observation. Riders need to be among the first to cross the intersection when a green light is, especially during rainy conditions. A study by Paimana et al. (2020) found that 87% of motorcyclists prefer to maneuver in a queue when there is a red light.

The type of intersection plays a vital role in influencing risky riding behaviors among food delivery riders at signalized intersections in Malaysia. It was found an unfastened helmet and red-light running are more likely to happen at the T-junctions compared to cross junctions. This is in line with research by Rusli et al. (2020), which found motorcyclists were more likely to reduce red light running at cross junctions. The previous literature has explained that motorcyclists engage more frequently in risky riding behaviours when the traffic volume is low (Rusli et al., 2020). However, Nguyen-Phuoc et al. (2020) found both riders and drivers tend to use turn signals more frequently on roads with less traffic volume. They explain that riders or drivers are more careful during riding or driving along the road with lower traffic volume because vehicles are likely to drive at in fast speed under this condition. This contradictory finding might be due to the locations of the study. The present study mostly observed the food delivery riders at the signalized intersections, whereas the previous study observed riders and drivers along the light traffic volume.

On the other hand, not wearing shoes, stopping after the stop line, and abrupt lane change more frequently happens at cross junctions. Therefore, the improvement of having an Advance Stop Line (ASL) is needed to reduce the conflict between a motorcycle and other road users, such as pedestrians and motor vehicles. Ramli et al. (2021) revealed that the implementation of ASL has proven significant in reducing the rate of traffic conflict and increasing safety among all motorcyclists, including delivery riders. The result showed that the average percentage of motorcycles stopping before or behind stop space at an intersection without ASL was 46.2% compared with the implementation of ASL at 11.4%. The provision of ASL gives more space for motorcyclists to stop during the red traffic phase without stopping between other vehicles.

As mentioned before, food delivery riders engage more frequently in risky riding behaviours when the traffic is low. However, this current study also found that food delivery riders are less likely to run a red light and use a mobile phone on minor roads approach, which generally have less traffic volume. This finding is consistent with a previous study conducted among motorcyclists (Rusli et al., 2020). This contradicting finding merits further investigation to explain the specific factors in the study locations.

CONCLUSION

This study aims to determine factors influencing risky behaviours among delivery riders at signalized intersections. A total of 19,803 food delivery riders were observed for four days observations at four signalized intersections in Subang Jaya, Malaysia. This study develops seven risky riding behaviours (i.e., unfastened helmet, not wearing shoes, incomplete set of side mirrors, red light running, mobile phone use, stopping after a stop line, and abrupt lane change). This study confirms that some factors influencing risky riding behaviours among food delivery riders differ from general motorcycle riders. Findings showed that some of the explanatory variables were found statistically in certain risky behaviours models except for the incomplete set of side mirrors, where no explanatory variables were statistically significant in this model. Unfastened helmets increased at T-junctions compared to cross-junctions, whereas not wearing shoes was recorded to be significant at cross-junctions. The tendency of delivery riders to run a red light higher on weekends, during a clear day, on the T-junctions, and approaching from the major road. The use of the mobile phone is most likely to occur on weekends, during a clear day, and riders' approach from a major road. Stopping after stop line behaviours increase during peak hours and at cross junctions. Finally, abrupt lane change behaviour is more likely to happen on weekdays, during a clear day, and at cross junctions. The results from this study could help related authorities in preparing safety programs focusing on food delivery riders.

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