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RESEARCH ARTICLE

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Motorcycle risky behaviours and road accidents among adolescents in Jakarta metropolitan area, Indonesia

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ABSTRACT

Introduction: Underage motorcycle riding in Indonesia has long been and continues to be common among its citizens. This study aimed to analyse motorcycle risky behaviours associated with motorcycle accidents among adolescents in Jakarta metropolitan area. This is a cross-sectional study employing a self-report survey of 3880 students from 37 junior and senior high schools in the Jakarta metropolitan area, Indonesia, between April and June 2019. About 40% of the respondents reported that they ever involved in motorcycle accidents in the past 12 months. Speeding, using a mobile phone, drowsy driving, and wrong-way riding were significantly associated with motorcycle accidents. Further, red-light running, applying sudden brake, eating, smoking or drinking, listening to music, drunk driving and drowsy driving have an influence on the severity of motorcycle accidents. 91.3% of motorcycle drivers in our samples did not have a driving license, and approximately 39% of them had involved in motorcycle accidents. More stringent controls from parents, schools and the government are needed to inhibit motorcycle use by minors.

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Introduction

Globally, the age-standardized incidence rates of road injuries in 2017 were 692 per 100,000, where that figure was 11 times higher than those in 1990 (James, 2020). At the moment, road injuries were the eight-leading cause of death for people of all ages and becoming the leading cause of death for children and young adults aged 5–29 years worldwide (World Health Organization, 2018). Indonesia becomes one of the five countries with the greatest disability-adjusted life years (DALYs) of road traffic incidents in the world (Dalal, 2013). The number of traffic incidents in Indonesia has increased 3.30% annually from 2014 to 2018 (BPS-Statistics Indonesia, 2019). In 2018, there were 109,215 traffic incidents, with 29,472 deaths and 13,315 serious injuries (BPS-Statistics Indonesia, 2019). It was estimated that there were 213,866-million-rupiah loss with those high incidents due to traffic road incidents (BPS-Statistics Indonesia, 2019). Traffic accidents were dominated by motorcycles, with more than 70% of the total traffic accidents (Directorate General of Land Transportation of Ministry of Transportation of Republic Indonesia, 2019).

Motorization in Asian countries has been proliferating, and the motorcycle is the dominating transportation mode (Abdul Manan & Várhelyi, 2012). Globally, Indonesia ranks three with the highest number of motorcycles per 1000 population (World Health Organization, 2013). The number of motorcycles increases around 6.61% annually, from 114 million in 2014 to 146 million in 2018 (BPS-Statistics Indonesia, 2019). About 81.8% of land transportation in Indonesia was dominated by motorcycles (BPS-Statistics Indonesia, 2019). Unfortunately, increasing motorcycles becomes one of the most challenging tasks in reducing road traffic accidents. A research study showed an increase in motorcycle accidents occurred in the same period in which there was an increase in motorcycle sales in the country (Oliveira et al., 2016). Motorcycle accidents in Indonesia were dominated by the 15–19 age group with 15.03%, followed by the 20–24 age group with 14.18% (Iman, 2013). Global condition also shows a similar pattern where road traffic injuries are currently the leading cause of death for children and young adults aged 5–29 (World Health Organization, 2013).

Youth is the population most at risk for unsafe driving. They often look for sensations, such as reckless motorcycle riding, endangering themselves or other people. Sensation seeking, amiability and impatience are personality attitudes that may lead to risky driving, particularly for young riders (Wong et al., 2010). Moreover, overconfidence is claimed as the primary cause of unsafe driving behaviour for young riders (Clarke, 2007). The incomplete development of one of the brain parts, namely the prefrontal cortex – the part of the brain that has executive functions in the process of high-order thinking, moral intelligence, judgment, decision

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making and self-control – is responsible for the condition of adolescents who tend to take risks and seek novelty (Alaydrus, 2017; Giedd, 2012; Institute of Medicine (US) and National Research Council (US) Committee on the Science of Adolescence, 2011).

The human factor dominantly caused motorcycle accidents. Indonesian Police Data showed that around 61% of motorcycle accidents were caused by human factors, such as careless driving, fatigue driving, and tired and drunk driving (the Indonesian Traffic Police, 2013). World Health Organization stated that motorcycle accidents' main factors include speeding, drunk/drug driving, not wearing a helmet, and mobile phone use (World Health Organization, 2004b). A study in Iran identified seven accident-related risk behaviours: performing stunts, disobeying traffic rules, driving under the influence of drugs or alcohol, riding without proper skills or qualifications, transporting passengers illegally, transporting cargo illegally and not wearing a helmet (Zamani-Alavijeh et al., 2009). Another research study showed that calling, wrong-way riding, drunk riding and sidewalk riding were associated with crash injuries among motorcyclists (Truong et al., 2019).

The data have shown that human factors are the most dominant factors in causing motorcycle traffic accidents. Although several research studies have demonstrated various motorcycle risky behaviours were associated with motorcycle accidents among young adults or university students, there is a paucity of research identifying adolescents' motorcycle risky behaviours and their association with motorcycle accidents. However, various factors, such as parents' permissive attitude and peers' influence, made underage motorists increasingly widespread in Indonesia (Nurlia et al., 2017). Moreover, understanding several motorcycle risky behaviours among adolescents is essential to developing effective interventions to prevent more accidents, specifically among adolescents (Truong et al., 2018). Therefore, this study aims to analyse motorcycle risky behaviours associated with motorcycle accidents among adolescents in the Jakarta metropolitan area. We hypothesize that adolescents' motorcycle risky riding behaviours are associated with higher rates of their motorcycle accidents. Also, we hypothesize that adolescents riding a motorcycle with risky behaviours are more likely to have more severe motorcycle accidents.

Materials and methods

We distributed a cross-sectional, self-report survey to students in high schools in Jakarta Metropolitan Area, Indonesia, between April and June 2019. The Jakarta metropolitan area expands outside of *Daerah Khusus Ibukota Jakarta* [DKI Jakarta]: Special Capital Region of Jakarta and includes Bogor and Bekasi in West Java Province and Tangerang in Banten Province (Yamashita, 2017). With the total number of 15.5 million motorcycles in 2017, the Jakarta metropolitan area was chosen as the study location given its highest number of motorcycles compared to other provinces in Indonesia (BPS-Statistics Indonesia, 2018).

The formula of hypothesis testing for two population proportions was used for determining the minimum sample size. With 95% confidence interval (CI), the minimum sample size was 1668 respondents. Therefore, a total of 4025 students were recruited in this study. A total of 37 junior and senior high schools were selected by non-random convenience sampling. From the selected schools, three classes representing each grade were randomly selected. In the selected classes, all students were recruited. After selected schools have agreed to participate, then the students in each class were approached. The survey was managed by trained research assistants and was carried out in the classroom without the presence of the teacher. Informed consents were obtained prior to questionnaire distribution, and respondents were given a brief orientation on how to fill out the questionnaire. This study was approved by the Committee on Health Research Ethics of *Universitas Muhammadiyah Prof. DR. HAMKA* Number 03/19.05/030, and institutional permissions were obtained from each school prior to study.

The survey instrument consisted of four parts. The first part of the survey contained questions about socio-demographic characteristics, including sex, age, school, class grade, address and parents' income. The second part of the survey included questions on motorcycle usage status. This section describes whether the students can ride the motorcycles or not. We categorized students as motorcycle riders if they reported actively riding motorcycles, not as passengers, within the past 30 d. The students who were not able to ride a motorcycle were excluded from this study. As defined by WHO, a motorcycle is a two-wheeled motor vehicle with one or two riding saddles and sometimes with a third wheel to support a sidecar, including moped, motor scooter and motorcycle (World Health Organization, 2004a). Other questions in the survey explored motorcycle driving license ownership and motorcycle riding frequency per day. The third part of the questionnaire explored risky motorcycle riding behaviour. Risky behaviours have been determined by exploring three Indonesian government regulations regarding motorcycle riding requirement and guideline, namely 1) Indonesian Government Law Number 22 of 2009 on Traffic and Road Transport, 2) Ministry of Transportation Republic of Indonesia Regulation Number 12 of 2019 on Community Motorcycle Safety, and 3) Directorate General of Land Transportation of Ministry of Transportation of Indonesia on Motorcycle Riding Guidelines in Indonesia (Directorate General of Land Transportation of Ministry of Transportation of Republic Indonesia, 2009; Ministry of Transportation of Republic of Indonesia, 2019; Republic of Indonesia, 2009). Questions regarding motorcyclists' risky behaviours were also adapted from a previous research study of behaviour of motorcyclists disregarding regulations in urban areas of Indonesia. Four Likert scale items were used to identify attitude variables from Very Often to Never (Susilo et al., 2015). Based on those works of literature, we identified a great number of risky behaviours, such as red-light running, sidewalk riding, wrong-way riding, not turning on turning-lamp (indicator light) when turning, not turning on headlights during the day, carrying overweight goods, driving with more than one passengers, speeding, applying sudden brakes, eating, smoking or drinking while driving, calling or texting while driving, mobile phone use

while driving, listening to music while driving, drowsy driving, not wearing a helmet, not wearing safety equipment, such as jackets and gloves and reckless driving.

The fourth part of the questionnaire provided information on the frequency of motorcycle crashes/falls in the past 12 months. If so, participants were asked whether they fell from their motorcycle without contact with either an obstacle or another road user, whether they fell from their motorcycle due to hitting an obstacle, whether they crashed into another road user, and whether some other road users crashed into them. Questions regarding crash/fall involvement were adapted from a previous research study of mobile phone use while riding a motorcycle among university students (Truong et al., 2019). Later, the question was followed up with a question about the severity of the most recent crash/fall. Based on the Indonesian road traffic law, traffic accidents were categorized into three degrees: minor, moderate and major accidents. The minor accident results only in damage in the vehicle without resulting in a wound or injury. In contrast, a moderate accident is an accident resulting in minor injuries and damage to the vehicle. Meanwhile, a major accident is an accident resulting in disability or injuries requiring inpatient hospital care (Republic of Indonesia, 2009).

All statistical tests were analysed using statistical software. Descriptive statistics were computed for categorical variables by computing their frequencies and percentages. For all respondents, the dependent variable of having had an accident was categorized as having had an accident and never having an accident. The dependent variable for motorcycle severity accidents was categorized as major accident, moderate accident and minor accident. Chi-Square and ordinal regression tests were employed to determine associations between independent and dependent variables. Bivariate analysis also was used to determine the inclusion of variables in the multivariate analysis where independent variables with p value < .25 in bivariate tests were included in the multivariate analysis (Hosmer et al., 2013). Multivariate analysis was performed using logistic binary regression on the dependent variable on accident, while ordinal logistic regression was used on the dependent variable accident severity. Multivariable binary logistic regression and ordinal logistic regression were performed to identify potential predictors or factors associated with motorcycle accidents and accident severity in each variable, respectively. In the multivariable binary logistic regression analysis, backward elimination was conducted to find the set of best predictors of motorcycle accident. The strength of the statistical association was measured by adjusted odds ratios (AORs) and 95% CIs. In binary logistic regression analysis, the odds ratio is seen from the exponential value of beta. In the ordinal logistic regression analysis, the AOR is obtained by calculating the exponential value of the estimate. An association with $p < .05$ was considered significant.

Results

A total of 3880 (96.39%) respondents completed all questions on the survey. Respondents who never used motorcycles were excluded from further analyses (1509 respondents, 38.89%). Thus, all further analyses were based on a sample of 2371 respondents. The respondents' characteristics and frequency of motorcycle crash experience are described in Table 1. The respondents were 53.7% female and 46.3% male, with the mean age of respondents was 15.4 years old (SD: 1.45, min: 12 years old, max: 21 years old). The distribution of motorcyclists was relative from inside and outside Jakarta, with 57.1% from Jakarta and 42.9% from outside Jakarta. More than half of our respondents (60.9%) reported that they were never involved in motorcycle accidents, and 20.2% experienced minor accidents in the past 12 months. In our sample, approximately 91% of motorcycle riders did not have a motorcycle driving license.

Table 2 reports on the frequency of risky behaviours of motorcycle riders. The most frequent motorcycle risky

Table 1. Respondents' motorcycle accidents by sociodemographic variables.

	No accident 1445 (%)	Minor accident 479 (%)	Moderate accident 414 (%)	Major accident 33 (%)	Total 2371 (%)
Age					
< = 14	380 (65.6)	108 (18.7)	85 (14.7)	6 (1.0)	579 (24.4)
15	231 (58.5)	74 (18.7)	86 (21.8)	4 (1.0)	395 (16.7)
16	500 (59.5)	181 (21.5)	151 (18.0)	9 (1.0)	841 (35.5)
> = 17	334 (60.1)	116 (20.9)	92 (16.5)	14 (2.5)	556 (23.4)
Sex					
Male	662 (60.4)	222 (20.2)	190 (17.3)	23 (2.1)	1097 (46.3)
Female	783 (61.4)	257 (20.2)	224 (17.6)	10 (0.8)	1274 (53.7)
School type					
Private	954 (59.9)	327 (20.6)	285 (17.9)	26 (1.6)	1592 (67.1)
Public	491 (63.0)	152 (19.5)	129 (16.6)	7 (0.9)	779 (32.9)
Education					
Junior high school	450 (64.2)	134 (19.1)	110 (15.7)	7 (1.0)	701 (29.6)
Senior high school	995 (59.6)	345 (20.7)	304 (18.2)	26 (1.5)	1670 (70.4)
Domicile					
Jakarta	836 (61.8)	266 (19.7)	226 (16.7)	25 (1.8)	1353 (57.1)
Outside Jakarta	609 (59.8)	213 (20.9)	188 (18.5)	8 (0.8)	1018 (42.9)
Motorcycle driving license					
Having	122 (58.9)	37 (17.9)	36 (17.4)	12 (5.8)	207 (8.7)
Not having	1323 (61.1)	442 (20.4)	378 (17.5)	21 (1.0)	2164 (91.3)

Table 2. Frequency of risk while riding motorcycle.

Variables	$n = 2371$			
	Never	Seldom	Sometimes	Very often
Red light running	1862 (78.5)	389 (16.5)	60 (2.5)	60 (2.5)
Sidewalk riding	1946 (82.1)	292 (12.3)	49 (2.1)	84 (3.5)
Wrong way riding	1178 (49.7)	949 (40.0)	148 (6.3)	96 (4.0)
Not turning on indicator lamp when turning	1519 (64.1)	347 (14.6)	240 (10.1)	265 (11.2)
Not turning on head-lights during the day	966 (40.7)	272 (11.5)	575 (24.3)	558 (23.5)
Driving with more than one passenger	757 (31.9)	1211 (51.1)	279 (11.8)	124 (5.2)
Never checking vehicle routinely	551 (23.2)	362 (15.3)	1021 (43.1)	437 (18.4)
Speeding	627 (26.4)	1156 (48.8)	406 (17.1)	182 (7.7)
Applying sudden brakes	709 (29.9)	1401 (59.1)	202 (8.5)	59 (2.5)
Eating, smoking or drinking	1637 (69.0)	556 (23.5)	99 (4.2)	79 (3.3)
Using mobile phone	1620 (68.3)	577 (24.3)	94 (4.0)	80 (3.4)
Listening to music	1346 (56.8)	671 (28.3)	228 (9.6)	126 (5.3)
Drowsy driving	1142 (48.2)	962 (40.6)	197 (8.2)	70 (3.0)
Drunk driving	2201 (92.8)	48 (2.0)	24 (1.0)	98 (4.2)
Not wearing a helmet	662 (27.9)	291 (12.3)	900 (38.0)	518 (21.8)
Not wearing safety equipment	286 (12.1)	339 (14.3)	1047 (44.2)	699 (29.4)
Reckless driving	1394 (58.8)	437 (18.4)	321 (13.5)	219 (9.3)

behaviours reported by respondents were not wearing safety equipment, such as jackets and gloves (29.4%), not turning on headlights during the day (23.5%) and not wearing a helmet (21.8%). More than 10% of riders occasionally not turning on the indicator lamp when turning, not turning on headlights during the day, driving with more than one passenger, never checking the vehicle routinely, speeding, not wearing a helmet, not wearing safety equipment and reckless driving. Approximately, more than half of respondents stated they had never committed red-light running, sidewalk riding, not turning on the indicator lamp when turning, eating, smoking or drinking, using a mobile phone, listening to music while driving, drunk driving and driving recklessly.

Table 3 shows the association between several motorcycle risky behaviours and motorcycle crashes. Numerous risky behaviours were significantly associated with motorcycle crash accidents. For those who have ever done some risky behaviours during riding a motorcycle, such as red-light running, sidewalk riding, wrong-way riding, driving with more than one passenger, speeding, applying sudden brakes, eating, smoking or drinking, using a mobile phone, listening to music, drowsy driving, not wearing a helmet and not wearing safety equipment, had significantly higher ORs for experiencing motorcycle crash accidents. Moreover, not having a driving license, not turning on the indicator lamp when turning and headlights during the day, never checking vehicle routinely, driving recklessly and drunk driving were not significantly associated with motorcycle crash accidents.

Table 4 shows the multivariate logistic regression. The model was statistically significant because the significance level of p in the Hosmer–Lemeshow test was found to be higher than the significance value of .05 (.970). Moreover, the χ^2 value was calculated to be 108.607 with a significance of .000, in comparison with 9.49, which represents an χ^2 table value with 4 degree of freedom at alpha significance level (.05), the model established was confirmed to be significant in general. However, Nagelkerke R square in this study was only 0.061, which is considerably low. This can be because various factors were not examined in this study, which could affect motorcycle accidents, such as the influence of physical environment and vehicle condition. The results showed that using a mobile phone while riding was associated with a higher chance of experiencing motorcycle accidents (AOR: 1.60, 95% CI: 1.32–1.93). Moreover, motorcycle riders who did speeding compared to those who did not do speeding had an increased likelihood of experiencing motorcycle crash 1.4 times (AOR: 1.44, 95% CI: 1.18–1.77). Similarly, motorcycle riders who frequently committed drowsy driving and wrong-way riding were times more likely to experience motorcycle crash than those

Table 3. Bivariate analysis for assessing the relationship of motorcyclist risky behaviour with motorcycle accidents.

Variables	Involving motorcycle accident in the past 12 months			
	Yes	No	Odds ratio (95% CI)	p Value
Not having driving license	841 (38.9)	1323 (61.1)	0.91 (0.68–1.13)	.586
Red light running	241 (47.3)	268 (52.7)	1.55 (1.27–1.88)	<.001
Sidewalk riding	209 (49.2)	216 (50.8)	1.66 (1.34–2.05)	<.001
Wrong way riding	547 (45.9)	646 (54.1)	1.79 (1.51–2.11)	<.001
Not turning on indicator lamp when turning	95 (35.8)	170 (64.2)	1.17 (0.89–1.52)	.285
Not turning on head-lights during the day	211 (37.8)	347 (62.2)	1.07 (0.88–1.30)	.524
Driving with more one than passengers	668 (41.4)	946 (58.6)	1.37 (1.14–1.64)	.001
Never checking vehicle routinely	153 (35.0)	284 (65.0)	1.24 (0.99–1.54)	.062
Speeding	743 (42.6)	1001 (57.4)	1.80 (1.48–2.19)	<.001
Applying sudden brakes	707 (42.5)	995 (57.5)	1.66 (1.37–2.00)	<.001
Eating, smoking or drinking	345 (47.0)	389 (53.0)	1.61 (1.35–1.92)	<.001
Using mobile phone	380 (50.6)	371 (49.4)	2.02 (1.69–2.40)	<.001
Listening to music	459 (44.8)	566 (55.2)	1.53 (1.29–1.80)	<.001
Drowsy driving	552 (44.9)	677 (55.1)	1.67 (1.42–1.98)	<.001
Drunk driving	63 (37.1)	107 (62.9)	0.91 (0.66–1.26)	.637
Not wearing helmet	178 (34.4)	340 (65.6)	1.29 (1.05–1.58)	.015
Not wearing safety equipment	239 (34.2)	460 (65.8)	1.34 (1.17–1.61)	.002
Reckless driving	73 (33.3)	146 (66.7)	1.31 (0.97–1.76)	.080

Table 4. Logistic regression results for being involved in a motorcycle accident by risky behaviours (fit model).

Variables	Estimate	Standard error	Wald	*p* Value	Adjusted odds ratio	95% CI
Wrong way riding	0.35	0.09	14.87	.000	1.42	1.18–1.69
Speeding	0.37	0.10	12.53	.000	1.44	1.18–1.77
Using mobile phone	0.47	0.09	23.80	.000	1.60	1.32–1.93
Drowsy driving	0.25	0.09	7.49	.006	1.28	1.07–1.53
Constant	−2.63	0.24	126.29	.000	0.07	–

Table 5. Bivariate analysis for assessing the relationship of motorcyclist risky behaviour with motorcycle severity accident.

Variables	*β*	Odds ratio	95% CI	*p* Value
Not having driving license	0.60	1.83	1.17–2.84	.008
Red light running	0.37	1.45	1.93–1.08	.012
Sidewalk riding	0.23	1.25	0.92–1.71	.146
Wrong way riding	−0.03	0.97	0.77–1.29	.979
Not turning on indicator lamp when turning	−0.20	0.82	0.54–1.24	.341
Not turning on head-lights during the day	0.05	1.05	0.78–1.42	.753
Driving with more than one passenger	−0.12	0.88	0.67–1.17	.395
Never checking vehicle routinely	0.36	1.44	1.01–2.04	.042
Speeding	−0.12	0.89	0.64–1.22	.467
Applying sudden brake	−0.23	0.80	0.59–1.07	.137
Eating, smoking or drinking	0.41	1.51	1.97–1.16	.002
Using mobile phone	−0.24	0.79	0.61–1.02	.068
Listening to music	0.35	1.41	1.82–1.09	.008
Drowsy driving	−0.22	0.80	0.62–1.04	.093
Drunk driving	0.83	2.28	3.82–1.37	.002
Not wearing a helmet	0.08	1.08	0.79–1.50	.624
Not wearing safety equipment	−0.01	0.99	0.74–1.33	.958
Reckless driving	−0.03	0.97	0.61–1.56	.913

Table 6. Multiple ordinal logistic results for severity motorcycle accident by risky behaviours.

Variables	*β*	Adjusted odds ratio	95% CI	*p* Value
Red light running	0.31	1.36	1.11–1.68	.003
Applying sudden brake	0.28	1.32	1.09–1.62	.004
Eating, smoking or drinking	0.35	1.42	1.17–1.70	.000
Listening to music	0.28	1.32	1.12–1.57	.001
Drowsy driving	0.30	1.35	1.14–1.62	.001
Drunk driving	0.57	1.77	1.25–2.48	.001

who did not do drowsy driving (AOR: 1.28, 95% CI: 1.07–1.53) and wrong-way riding (AOR: 1.42, 95% CI: 1.18–1.69).

Table 5 presents the bivariate analysis of motorcycle accident severity. The motorcycle accident severity was statistically significant difference for those who did not have a driving license, red-light running, never checking the vehicle routinely, eating, smoking or drinking, listening to music, and drunk driving as compared to those who did not do those motorcycle risky behaviours.

Table 6 shows the multivariate linear regression analysis. The results revealed that red-light running, applying sudden brake, eating, smoking or drinking, listening to music, drowsy driving and drunk driving had an influence on the severity of motorcycle accidents. Riders who reported having experienced motorcycle accidents when running in the red-light and applying sudden brakes were approximately 1.3 times as likely to be injured (AOR: 1.36 and 1.32, respectively). Drunk riders were approximately 1.7 times as likely to be injured. Also, riders who reported having experienced an accident when they did eating, smoking or drinking, or listening to music were more likely to be injured (AOR: 1.42 and 1.32, respectively).

Discussion

This study highlighted that more than half of the participants ($n = 2371$, 61.1%) had utilized the motorcycle as common transportation. These findings are also widely reported on several research outcomes in other countries, indicating a motorcycle is already part of the daily life (Abegaz & Gebremedhin, 2019; Bodalal et al., 2012; Gathecha et al., 2018; Guo, 2017; Sadeghi-Bazargani, 2016; Thor & Gabler, 2010). Moreover, of which 2371 motorcycle riders in this study, almost 40% of them were under 16 years old. Unfortunately, a large number of motorcycles used by adolescents had a positive correlation with the increasing prevalence of crashes among adolescents and also had the highest mortality rates in road accidents (Sadeghi-Bazargani, 2016). Psychologically, adolescents are more likely to underestimate or unable to recognize dangerous situations while driving (Jonah & Dawson, 1987).

In the Indonesian context, it is illegal to drive a motorcycle without an appropriate license in which failing the license to authorities will have legal consequences. The Indonesian government has regulated that 17 years old was a minimum age in obtaining all type C driving license, which is used for legally driving motorcycles. Particularly, there are three types of type C driving license; C1 type driving license is used for driving a motorcycle with engine under 250 cubical centimetre (cc/cm^3); C2 type is used for a motorcycle with engine between 250 and 750 cc, and C3 type is used for a with motorcycle engine above 750 cc. Besides the age requirement, someone who wants to get a driving license must also pass an exam consisting of a theory test, a skills test *via* a simulator, and a practical exam. A person who wants to get a driving license is also required to take part in an educational session by the Police related to laws and regulations in the field of road traffic and transportation; traffic ethics; security, safety, order and smooth traffic; various forms of traffic violations; traffic accidents and traffic accident rescue procedures (The Indonesian National Police, 2012).

Some reasons underlie why parents in the Jakarta metropolitan area allow their children to use motorcycles to school. School bus drivers could not reach some residential areas, and the students are worried about taking public transportation because of the criminal issues, for instance, robberies, kidnappings and sexual harassment (The Jakarta Post, 2013). Another reason why the motorcycle has become a primary necessity in transportation was geographic location and minimum public transport (Scott-Parker, 2013; Simons-Morton et al., 2008). It might be caused by the unintegrated transportation system and residential areas that

are not accessible *via* public transport. It drives parents to buy motorcycles to reduce the burden of the family's economic expenditure (Bodalal et al., 2012). Lifestyle change factors due to social structure transformation might also affect the increasing number of motorcycle users among adolescents (Watson, 2007; Tunnicliff 2012). The high demand for public dependence on motorcycles dominantly on mobility and economic factors affects sociological lifestyle patterns. It affects the ability of the family to purchase motor vehicles (Gathecha et al., 2018). Moreover, the Indonesian Financial Services Authority (OJK) regulates that multi finance could provide service to the community with a 0% down payment programme on purchasing vehicles. It makes the motorcycle more affordable, even for low socio-economic communities (The Jakarta Post, 2019).

This study reported that 48.8% of respondents seldom did speeding while driving motorcycles. The youth perceived that speeding demonstrated a sense of pride and exceptional skills, better than those who did not speed (Ferguson, 2013). Speeding has an impact on riders and increases the chance of severe injury or death among all road users including pedestrians and passengers (Wang et al., 2010). Speeding is much more likely to be a factor in a fatal crash when the driver is under 25 years old (Organisation for Economic Co-operation & Development, 2006). Another risky behaviour significantly associated with the motorcycle accident was wrong-way riding. Wrong-way riding for motorcycle riders, specifically in certain areas in the Jakarta Metropolitan area, was common despite the police and government effort to put the traffic sign and traffic lamp to warn (Ravel, 2018). A common wrong-way riding is due to shorter-distance travel and time-saving (Sasambe, 2016).

Those who were using a mobile phone while driving increases 1.60 times to get involved in motorcycle accidents. Another research study among university students in Vietnam also showed similar results that motorcycle riders who do texting and searching for information on their mobile phones while riding were likely to be involved in a motorcycle crash/fall (Truong et al., 2018). Indeed, distracted driving is a growing threat to road safety, such as the use of mobile phones and other in-vehicle technologies (Organisation for Economic Co-operation & Development & World Health Organization, 2018). Cognitive distraction and both manual and visual distractions could be caused by texting, even talking on mobile phones without holding or browsing a phone can reduce driving performance (World Health Organization, 2018).

This study found that there is an association between driving errors among adolescents, such as red-light running, applying sudden brake, eating, smoking or drinking while driving, listening to music, drowsy driving and drunk driving become risk factors in accidents severity. Many studies have also shown the same results as this study has (Ashraf et al., 2019; Sadeghi-Bazargani, 2016; Shaaban et al., 2020; Shope, 2006; Teoh & Campbell, 2010). Riders running the red lights were more likely to experience more severe accidents than those who do not. A research study showed that younger drivers were more likely to run the red light than older drivers (Porter & Berry, 2001). Being in a hurry, impatient or angry, and lack of law obedience were reasons underlying motorcycle riders ignoring traffic lights at junctions (Susilo et al., 2015).

Mistakes in driving are influenced by police supervision on highways and adolescents' ignorance of safety regulations driving down the road (Alonso et al., 2017). Early adults apply driving safety if they feel supervised by the police or have gained socialization in driving at school. Psychological-social factors still dominate compliance and awareness in the safety of driving on roadways among early adults instead of adherence to applicable laws. There are many factors affecting adolescents in committing unlawful acts on the highway. In terms of psychological development, changes in the endocrine system during the puberty period could influence drives, motivation, mood and emotions that could have significantly impacted sensation-seeking and risk-taking behaviours (National Research Council (US), Institute of Medicine (US), 2007). Previous studies showed that higher rates of motorcycle accidents were associated with their difficulties in managing their emotional responses (Cerniglia et al., 2015; Cimino et al., 2018). Higher family support was expected to contribute to a more adaptive emotional-behavioural functioning of adolescents. This, in turn, decreases the likability of risky driving behaviour that might lower the rate of motorcycle accidents (Cerniglia et al., 2015).

This research study limits accidents reported only in the past 12 months so that some accidents occurring more than 12 months were underreported. This self-report study might be biased due to socially desirable responses associated with risky behaviours while riding. Crash/fall rates may also be underreported given that motorcyclists who have been seriously injured or killed while engaging in risky riding behaviours would not have been taking part in this study. This research study, which was undertaken in urban areas, might not be representative of adolescents in different settings, such as in rural areas.

Finally, the research showed several risky behaviours among adolescents' motorcycle driving and its correlation with motorcycle accidents and motorcycle severe accidents. The government needs to tighten the control to prevent minors and adolescents who still do not have a driving license to ride motorcycles. The authorities need to consider strict penalties that can deter students who do not have a driver's license not to ride a motorcycle, especially when going to school. Since it is known that some students ride motorcycles to go to school, the schools could conduct stricter supervision and prohibit students from riding motorcycles to school. School buses are one of the safest alternative transportation methods for students to go to school (Tetali et al., 2016). Therefore, local governments need to provide school buses, which can be used by various students, both who attend public and private schools and reach various areas where students live. Besides, campaigning traffic safety, such as the millennial road safety campaign performed by Indonesian Police, could be actively continued to send a clear message about safety riding. The campaign's ultimate goal is expected not only to increase youth knowledge regarding safety riding behaviour but also how to change

the image for the community that driving a motorcycle by minors is an unacceptable social practice. In addition, parents also need to be involved in reducing risky driving behaviours (Simons-Morton et al., 2008). Since previous evidence showed that teens' vehicle ownership was related to higher crash rates (Williams et al., 2006), parents are expected not to facilitate a motorcycle and not give permission for adolescents who do not have a driving license to drive a motorcycle. Parents are expected to be good role models in exemplifying safe driving behaviour so that children can imitate this behaviour when they start driving a motorcycle.

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