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Analysing Young Motorcyclist Trip and Parking Behaviours: A Strategy to Reduce Motorcycle Accident Numbers

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***Abstract*— Motorcycle numbers in Indonesia are growing rapidly and contribute 84.4% of total motor vehicles. The death numbers from road traffic accidents (RTA) involving motorcycles also increase to 74% of the deaths, including young motorcyclists. WHO reported that RTA is the leading cause of death for people aged between 5-29 years. A series of Revealed and Stated Preference surveys have been undertaken to explore the characteristics of young motorcyclist trips and their behaviors towards three different virtual parking schemes aimed at finding the best parking schemes to control motorcycle usage among young motorcyclists. Therefore, the number of young motorcyclist-related RTA could be reduced. The finding suggests that young motorcyclists preferred using off-street parking over on-street parking. The preferred distance between parking premises and activity centers is less than 50 meters. The off-street parking would be selected instead of the on-street parking, although its price is higher. The Willingness to pay for each proposed parking scheme is IDR 3,373, IDR 3,509, and IDR 3,618. It is below the ability to pay, which is IDR 4,100. Thus, an on-street parking scheme with progressive pricing and a minimum base price of IDR 5,000 is proposed, where at least 30% of parking lots should be allocated for short-term parking. Finally, the proposed parking scheme must be supported by reliable public transport services based on the young motorcyclist preferences, which would be the direction of future research.**

***Keywords*—Road traffic accident; young motorcyclist; motorcycle; parking scheme.**

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I. INTRODUCTION

Transport negative impacts are probably at an alarming level from more than a decade ago. Those include motor vehicle dependency, road congestion, air pollution, fossil fuel energy crisis and road traffic accidents (RTA). According to WHO, RTA is the 8th leading cause of death in the world [1], while in Indonesia, RTA is one of the highest causes of death [2]. Unbalance between the annual growth rate of roads and motor vehicle numbers was suspected as the main reason for the high RTA number in Indonesia [3]. The recorded annual length of road development in Indonesia is about 2500 Km or about 0.25 per cent [4]. In contrast, the average motor vehicle growth rate reaches almost 6 per cent per annum, where the total number of recorded motor vehicles is nearly 134 million units.

Figure 1 shows the number of motor vehicles for different categories in Indonesia [5]. It can be seen that the highest percentage belongs to motorcycles which is more than 84%. Passenger cars contribute slightly below 12%, and Buses only contribute less than one cent of the total number of motor vehicles which is significantly lower than other motor vehicles.

It seems there is a motorcycle dependency among road users in Indonesia. It also occurred in other developing countries such as Malaysia [6] and Thailand, as indicated by Chumpawadee et al. [7]. Consequently, motorcycles are often involved in RTA [8]. Obanife et al. [9] suggested that rapid urbanization, particularly in developing countries, contributes to more motorcycles involved in RTA. For example, motorcycles are the common transport mode in Nigeria, including for commercial purposes [10]. In a particular urban road, motorcycles could reach 80% of total motor vehicles [11]. It has become a major transport mode since the ease of finding parking spaces, the ability to keep moving during congestion [12], low operational cost [13], and also triggered by drawbacks in public transport services [14]. It is used for various trip purposes and even for public transport called motorcycle taxis [15]–[17] and tended to increase [18],

including in rural areas [19]. Its modified version, called the three-wheeler, also becomes a low-cost transport mode in rural areas [20]. Another form of motorcycle used for public transport services is Ride-Hailing Service (RHS) [21]. Examples are Grab and Gojek, two major RHS companies providing motorcycle-based RHS [22]. The massive usage of motorcycles and their modified version in developing countries result in the total number of RTA, which is led by mode of motorcycles like in Malaysia [23], Cambodia [24], Thailand [25] and also Indonesia. Especially in Indonesia, its number could reach about 74% of the total RTA number [1], where the percentage of death due to RTA age 10-24 is the highest [26]. According to WHO, injuries resulting from traffic accidents are the leading cause of death among young people aged 5 to 29 [1].

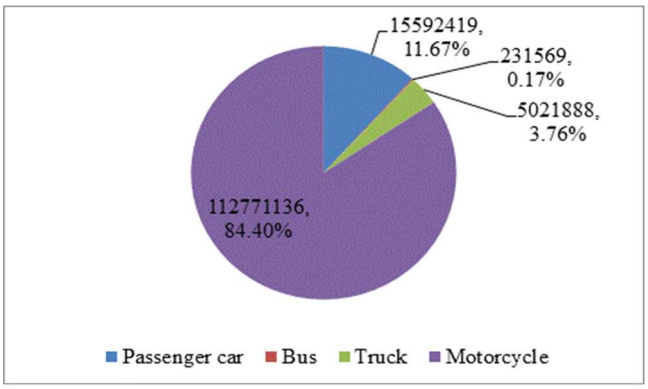

Fig. 1 Number of motor vehicles in Indonesia for different categories [5]

A considerable effort has been undertaken to study the negative impacts of motorcycles on road users so that proper strategies and policies can be proposed. It is essential since the prominent negative impact of motorcycles on road users is a high number of motorcycle-related RTA and its death, especially among young or student motorcyclists. Since young motorcyclists are often involved in RTA and are susceptible to injuries due to RTA [27], several researches have been undertaken to focus on young motorcyclists such as university and college students [7], [28], Secondary school students [29], RTA related to children [30], and RTA involving urban area children [31].

Chumpawadee et al. [7] investigated the factors of risk behaviors causing motorcycle accidents among 18-22 years old university students in Thailand by using a questionnaire. This study only examines factors associated with university student behaviors considered risky while using motorcycles. Firstly, the prominent risky behaviors found by this study include using mobile phones while driving motorcycles, speeding, driving with passenger numbers above their capacity, driving under alcohol influence, and using motorcycles without a helmet.

Furthermore, it was found that male motorcyclists have higher risky behaviors while using motorcycles than female ones. Next, motorcyclists with an experience more than five years would have a higher potential for risk behaviors compared to lesser experienced ones. However, motorcyclists with more knowledge of safe driving were found to use motorcycles more carefully.

Meanwhile, Ariffin and Setapani [29] studied helmet usage among secondary school students in Malaysia. The research was focused on the knowledge, attitude and practice involving secondary students located in urban and suburban areas where the participants are between 16-19 years old (the minimum age required to obtain a motorcycle license in Malaysia was 16 years).

It was found the majority of the students believed that helmets could save a life. However, nearly two-thirds of students ride motorcycles without helmets while travelling short distances. It could be related to trips to schools which could be considered short-distance travel. A study by Chaichan et al. [32] and Urrechaga et al. [33] suggested using full-face helmets could considerably minimize the injury in neck and head areas compared to other kinds of helmets. Thus, the usage of helmets among motorcyclists should be promoted more frequently through motorcycle safety campaigns [34].

Furthermore, the number of students who constantly used helmets was less than five per cent. This is dangerous since Chumpawadee et al. [7] suggested that riding motorcycles without helmets is one of the risky behaviors in motorcycle-related RTA. This behavior could be the same and found in other Asian developing countries. Despite knowing helmets can save lives, the students would remain to ride motorcycles unhelmet.

This is likely related to a lack of policies advocating for the students regarding road safety, poor law enforcement, and society's ignorance. Besides, the schools seem to facilitate the students using motorcycles for school purposes by providing parking areas inside the schoolyards. The unavailability of reliable and convenient public transport services worsens it. Therefore, alternative and effective solutions, for example, managing parking demand and supply for young motorcyclists, including students, are required.

Meanwhile, Vu and Nguyen [30] conducted an in-depth analysis regarding RTA involving children in urban areas. It includes the patterns and causes of the RTA towards time, location, vehicle type, age and gender. It was found that RTA involving children tends to significantly increase where the most vulnerable ones were high school students contributing up to 70% of total children-related RTA. The same trend also occurred in Malaysia [29] and Indonesia [26]. Further, Vu and Nguyen reported that based on the road user types, about 80% were secondary and high school-age children using bicycles, e-bikes or motorcycles as the rider.

More accidents were to occur after school hours on road sections where the main causes are wrong lane running, direction change, speeding, overtaking, and road crossing. Thus, death among children caused by RTA is already critical, and the majority were caused by the behaviors of these young riders while on the roads. Therefore, the number of young motorcyclists should be decreased, and they should be encouraged to use a safer transport mode like public transport.

Another study regarding RTA involving young motorcyclists in an urban area was also reported by Pratiwi and Siahaan [31]. The number of RTA involving children aged 14 years or lower in Indonesia was almost half of adult-related RTA. One-third of casualties are children aged 0-14 years old. Further, nearly 50% of the children related to RTA were by a mode of motorcycle. The perpetrators were the children still ineligible for motorcycle licenses since, in Indonesia, the minimum required age is 17 years old [35].

Meanwhile, several RTA in Indonesia based on road user categories were dominated by motorcycle riders, whose percentage is up to 74%. This percentage is significantly higher than other road users [1]. Thus, it could be assumed that a high and increasing number of RTA are strongly related to the high and increasing motorcycle growth rate. Most young motorcyclists related to RTA are also considered related to motorcycles as the transport mode. Previous studies regarding young motorcyclists' behaviors in using motorcycles indicated their behaviors using motorcycles are at high risk due to a lack of safety awareness despite knowing that riding a motorcycle poorly would lead to death. In contrast, motorcycles provide benefits for young motorcyclists, including conducting journeys at anytime and anywhere [36].

To decrease negative transport impacts, transport supply facilities must be increased, and their demand must be controlled [37]. Encouraging motorcyclists to shift to public transport is recommended as one of the global strategies to reduce RTA involving motorcycles in urban areas [38]. However, it must be supported by other schemes, for example, by controlling the parking supply to increase public transport shares. It is crucial because uncontrolled parking could cause parking space abuse, improperly parked vehicles, parking in prohibited zones, and interrupting and endangering traffic flow [39]. Further, improper on-street parking would decrease road capacity and congestion, as Alfaro et al. [40] reported. Wijayaratna [41] claimed that the road capacity would decrease by 17% due to on-street parking. It was also reported that long-term parking causes less impact than short-term ones.

However, previous parking studies focused on finding solutions so that road capacities could be increased, road congestion severity levels could be decreased, and hence air pollution could be minimized. It includes different parking scheme applications like paid and limited parking facilities to increase public transport shares and reduce CO2, as reported by Luathep et al. [42]. Further, Tsuboi [43] claimed that on-street and off-street parking in the CBD could be managed using parking control policies, so it is necessary to understand trip-maker parking behaviors.

Therefore, suitable parking policies should be defined and hence it could work effectively, like encouraging motorcyclists to shift to public transport services. Thus, the behaviors of trip makers related to different parking schemes must be assessed. It includes motorcyclist parking behaviors towards different virtual parking schemes, and hence young motorcyclist numbers could be reduced as well as its RTA.

Former studies indicate more attention was devoted to student trip behaviors while riding motorcycles. A lack of studies was reported regarding young motorcyclists using motorcycles as transport modes and their parking behaviors. This is crucial, especially once there is poor law enforcement, school and societal ignorance, and poor motorcyclist riding behaviors. In addition, the school are willing to provide its front yards for student parking areas. Thus, this study aims to examine the parking behavior of young motorcyclists and their behavior towards different virtual parking schemes. Hence, suitable parking policies could be proposed to reduce young motorcyclists-related RTA.

II. Materials and Methods

A. Padang City Profile

Padang is a medium-sized city located along the coastline of West Sumatra, Indonesia. The population is about one million, and 6.23% of them are students aged 16-18. The local Gross Domestic Product (GDP) recorded in 2020 was IDR 62,222 trillion or equal to USD 4,148,133 Billion (assuming USD 1= IDR 15,000). The transport sector contributes about 16.59% of Padang's GDP, which tends to be the highest compared to other sectors within 2018-2020 [44]. Compared to other cities in West Sumatra, Padang has the highest daily household trip number, about nine daily trips, and more than half of trips are commuting trips (work and school trips) [45]. RTA could cause an economic loss of up to 3.1% of GDP [46], and for Padang city, it equals about USD 128,592 Billion. This is significantly higher than the recorded loss due to RTA in Padang city, which was USD 136,322 thousand [44].

Recorded numbers of RTA that occurred in West Sumatra Province in 2020 were 2,554 cases, as seen in Figure 2.

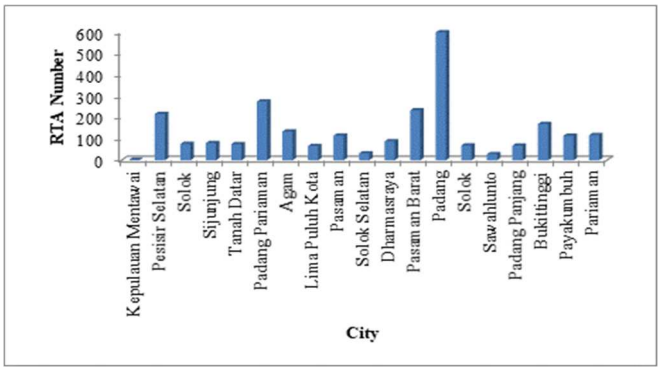

Fig. 2 Number of RTA for different cities in West Sumatra Province

This number is combined from 19 cities in West Sumatra Province. The highest one occurred in Padang city, with a percentage of 23.4%, significantly higher than other cities in West Sumatra Province [47]. Figure 3 shows motor vehicle numbers in Padang based on different motor vehicle categories. It tends to have a similar distribution as at the national level, where motorcycle numbers are significantly higher than other modes. Thus, the RTA was also dominated by motorcycles [48].

Figures 4-6 illustrate the young motorcyclists using motorcycles for school purposes at secondary schools in Padang. However, motorcycles are also used by young motorcyclists for other purposes such as working, shopping and social trips; hence, young motorcyclist-related RTA could also occur outside or after school hours [30].

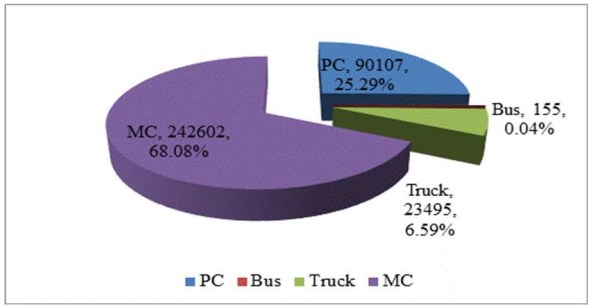

Fig. 3 Number of motor vehicles in Padang for different categories

These figures are examples of motorcycles parked by young motorcyclists, in this case, the students. It can be seen that motorcycles are parked inside school areas and along the street in front or near the schools, where parking rules such as parking signs and parking lots are unavailable along the parking precinct. It could also happen in other parking precincts such as markets, offices, sports centers and restaurants. This condition would trigger parking usage abusing and endanger other road users.

Fig. 4 Students using motorcycles as the main transport mode for school

Fig. 5 Students' motorcycles parked in the school front yard

B. Data Collection

To examine the young motorcyclist's trip and parking behaviors, it must be supported by a set of reliable data. The data collection was undertaken using direct interview surveys involving 227 young motorcyclists aged 16-22 from Monday to Sunday. Hence, the trip purposes were not limited to school purposes only but also for other types of trips. This is important since young motorcyclists related to RTA could be occurred during weekends and outside school hours where the trip purposes differ from school trips. There are four major universities in Padang; hence, a small portion of the university students were also involved in this study. The students were randomly selected in different locations, including schools, residents, and market areas.

Fig. 6 Students using on-street parking for motorcycles

The interview was conducted using three different Revealed Preference (RP) and Stated Preference (SP) modules, as reported in Table 1. Those modules are (1) Module 1, (2) Module 2, and (3) Module 3. The first RP survey was undertaken using Module 1 to collect the socio-economic and demographic of the young motorcyclists, such as gender, age, and motor vehicle ownership. This data is required to ensure the respondent has a motorcycle and uses it for different journey purposes.

TABLE I
SURVEY MODULES

Name	Remark	Survey type
Module 1	Respondent Socio-economic and socio-demography data, including gender, age, occupation, monthly income, household size, motor vehicle ownership, address	Revealed preference
Module 2	Respond trip characteristics, parking characteristics	Revealed preference
Module 3	Virtual proposed parking schemes	Stated preference

Then, the second RP survey obtains the existing trip and parking characteristics and behaviors through Module 2. It includes the trip origin and destination, trip purpose, and daily trip frequency. Further, the existing parking behavior, including frequency, fee, location, duration, distance, and a factor used in selecting parking locations, were also obtained through this survey. The last Module is an SP survey to explore the respondent's behavior and choice toward different parking schemes. Table 2 reports three different paid parking schemes and facilities used in this study. Those are (1) On-street parking with a fixed price, (2) On-street parking with a progressive price, and (3) Off-street parking with a progressive price. These three different parking schemes were offered to the young motorcyclists during the direct interview survey.

This SP module is designed in accordance with the purpose of this study to examine young motorcyclist parking preferences so that the best parking scheme can be proposed to reduce motorcycle usage by young riders and encourage them to use public transport services. Thus, three paid parking schemes with different payment methods and facilities are proposed, as reported in Table 2.

The base parking fees and designated parking facilities are determined according to the Padang government parking rules. The parking fee for motorcycles is currently IDR2000, applied more than a decade ago. This is considered cheap compared to the minimum petrol price in Padang, IDR7,650/liter. In addition, cheap parking fees would trigger more young motorcyclists. Therefore, the minimum parking fee for each scheme is increased and becomes IDR3500 or equal to USD 0.23.

It is expected the important variables for the young motorcyclist related to the parking could be identified. It comprises parking cost, parking location, parking distance to the activity center, Willingness to Pay (WTP), and Ability to Pay (ATP). This information could be extracted from RP and SP surveys. Thus, suitable parking policies in reducing motorcycle usage and RTA among young motorcyclists could

be proposed based on the combined RP and SP survey data analysis.

TABLE II
PROPOSED PARKING SCHEMES

Scheme 1 (on-street parking)			
Facility	**Base parking price (IDR)**	**Your Answer**	
Clear parking sign	3,500	Yes	No
Unlimited parking time	4,000	Yes	No
On-site parking machine	4,500	Yes	No
Fix parking price	5,000	Yes	No
	5,500	Yes	No
	6,000	Yes	No
Scheme 2 (on-street parking)			
Facility	**Base parking price (IDR)**	**Your Answer**	
Clear parking sign	3,500	Yes	No
Unlimited parking time	4,000	Yes	No
On-site parking machine	4,500	Yes	No
Fix parking price	5,000	Yes	No
Parking ranger	5,500	Yes	No
Progressive parking price	6,000	Yes	No
1st-hour parking price (see Table)			
Additional parking price after the 1st hour is IDR1,000/hour			
Scheme 3 (off-street parking)			
Facility	**Base parking price (IDR)**	**Your Answer**	
Clear parking sign	3,500	Yes	No
Unlimited parking time	4,000	Yes	No
On-site parking machine	4,500	Yes	No
Fix parking price	5,000	Yes	No
Parking operator	5,500	Yes	No
CCTV Camera	6,000	Yes	No
Progressive parking price			
1st-hour parking price (see Table)			
Additional parking price after the 1st hour is IDR1,000/hour			
Parking area located close to the activity center			

III. Results and Discussion

A. Existing Young Motorcyclist Trip and Parking Characteristics

Figure 7 shows the percentage of young motorcyclists based on education levels. More than 85% are senior high school students. The average income is significantly low since students usually provide daily or weekly allowance from their parents. Thus, free parking at schools or other activity centers would trigger more young motorcyclists to use motorcycles, and their allowance could be used for other needs, such as shopping and social activities.

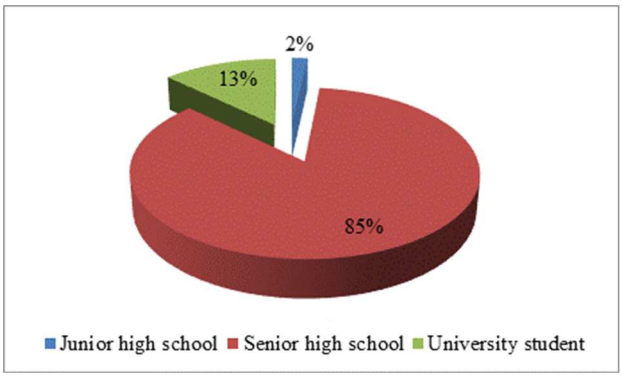

Fig. 7 Respondent percentages based on the education level

Figure 8 suggests that young motorcyclists also used motorcycles for shopping and working, with percentages of 17% and 6%, respectively. However, the highest percentage belongs to school trips. It means that young motorcyclists would also park in the market, office and other places.

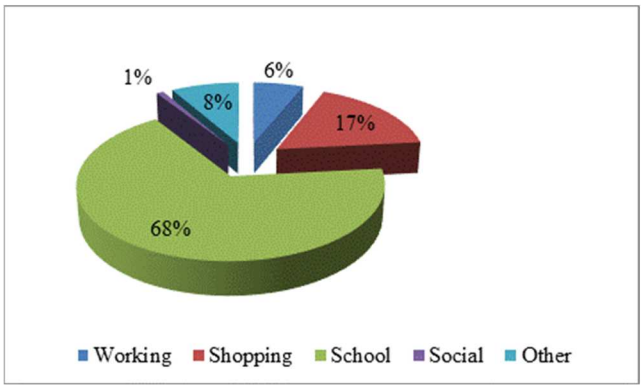

Fig. 8 Respondent percentages based on trip purposes

The majority of young motorcyclists park their motorcycles in off-street parking facilities like schoolyards, with the percentage 81.5%, and the others use on-street parking either along the street in front of the schools or in other roads near the activity centers like markets, offices and bookstores (see Table 3). This is considerably different from a previous study by Yaldi et al., where most trip makers used on-street parking [49]. It is likely influenced by the trip purposes, which are for working and shopping. The reason for using the existing parking facilities is mainly due to safety and distance aspects which are crucial to the unemployed young motorcyclists (see Figure 9).

However, more than a quarter of the young motorcyclists preferred to park on roadsides, as reported by Table 4, with different factors, as can be seen in Figure 10. It was also dominated by safety issues and distances. Young motorcyclists consider parking fees the last factor in selecting parking locations. It is likely due to free parking facilities provided by schools and limited allowance provided by their parents. Meanwhile, safety and distance factors are considered significantly important, referring to school parking areas.

TABLE III
EXISTING PARKING LOCATIONS

No.	**Parking location**	**% Respondent**
1	On-street	18.5
2	Off-street	81.5

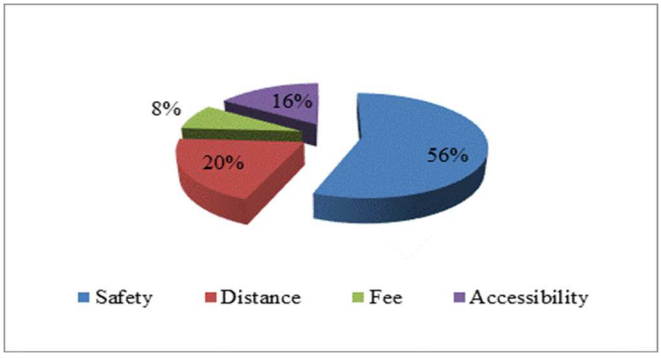

Fig. 9 Respondent percentages based on reason in selecting existing parking locations

TABLE IV
THE PREFERRED PARKING LOCATIONS

No.	Preferred parking location	% respondent
1	On-street	26.4
2	Off-street	73.6

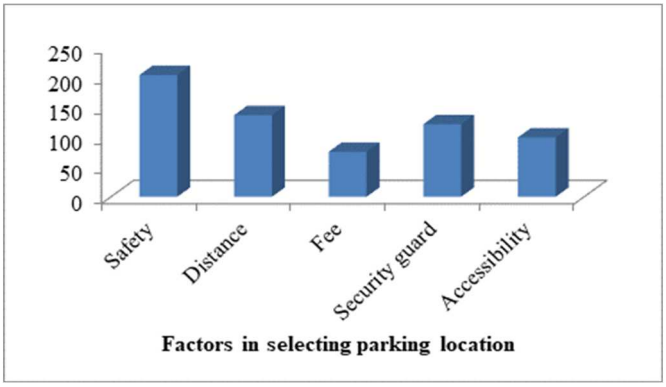

Fig. 10 Respondent percentages based on factors in selecting existing parking locations

Figure 11 and Table 5 show different parking durations among young motorcyclists, where the average parking duration is 1.94 hours. School trip purposes mainly impact this high duration. Parking duration at schools is longer than at other premises, depending on school hours and break time schedules.

The highest parking duration percentage is for long-term parking, which contributes about 39%, followed by medium-term and short-term parking, with percentages of 32% and 29%, respectively. The road transport authority could consider this distribution to allocate future parking lots, especially in reducing young motorcyclist numbers. For example, short-term parking lots should be provided more than long-term ones; hence, the young motorcyclists would experience difficulties finding parking lots based on their needs. This condition could be expected to prevent young motorcyclists from riding motorcycles and to consider using public transport services.

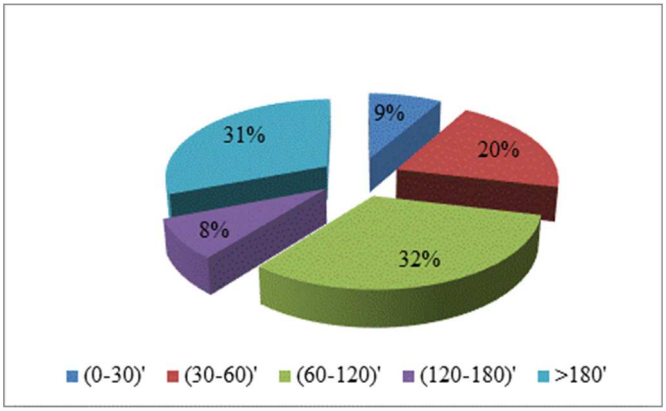

Fig. 11 Respondent percentages based on parking duration

The young motorcyclists were found to conduct trips more than twice a day and do the parking more than four times on a corresponding day. Figure 12 illustrates the parking cost distribution among young motorcyclists with an average parking cost of about IDR 1,500, which is much lower than the current minimum parking cost in Padang city. It was presumed that the parking cost would be dominated by free parking since about 68% of trip purposes of young motorcyclists are for schools, as shown in Figure 8. Thus, raising parking costs could encourage motorcyclists to shift to public transport [50].

TABLE V
YOUNG MOTORCYCLIST PERCENTAGE BASED ON PARKING DURATION

No.	Parking duration (minutes)	% Respondent
1	Short-term (<60)	29
2	Medium-term (60-120)	32
3	Long-term>120	39

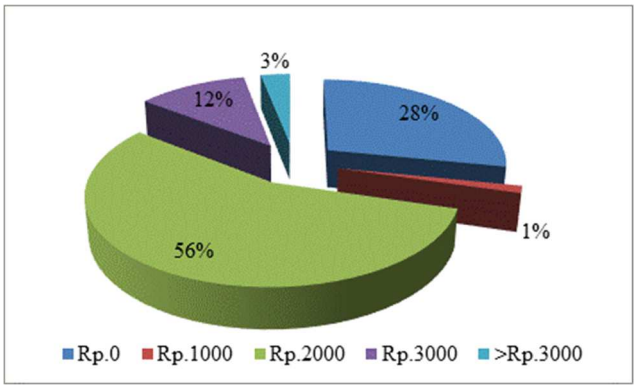

Fig. 12 Respondent percentages based on parking cost

In contrast, only 28% of young motorcyclists used free parking lots or less than half of school trip numbers, as depicted in Figure 13. Surprisingly, nearly two-thirds of young motorcyclists paid for their parking at schools with an average cost of almost IDR 2,400, which is much higher than the average parking cost for all trip purposes combined. It means that more than 70% of young motorcyclists used paid parking facilities at schools, with an average parking cost 20% higher than the minimum parking fee determined by the road transport authority.

The average distance from parking spaces to the activity centers varies from 0m to 200m, as seen in Figure 14. The average distance is less than 50 meters, which are very close to their destinations, from the front schoolyards to the classrooms at schools. It can be seen in Table 6 that the young motorcyclists' preferred distance from parking areas to the activity centers is 45.15m which is slightly lower than the real ones. It means the existing parking distance is almost fulfilling the preferred ones. It is likely because the transport modes are motorcycles which are much easier to find parking near the activity centers than passenger cars. The summary of existing young motorcyclist trips and parking characteristics is reported in Table 6.

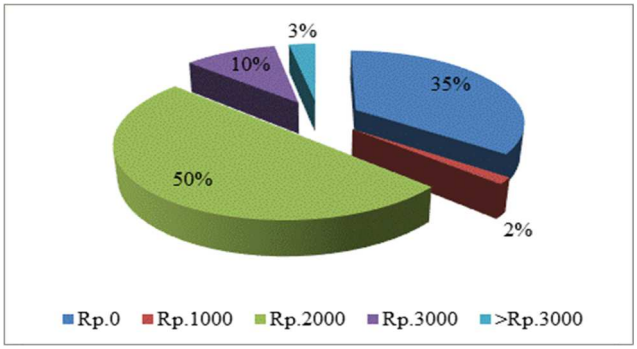

Fig. 13 Respondent percentages based on parking cost for a school trip

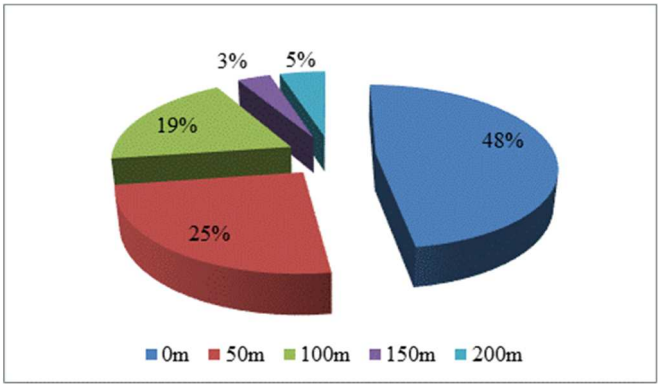

Fig. 14 Young motorcyclist percentages based on parking distances to the activity centers

TABLE VI
YOUNG MOTORCYCLIST PARKING CHARACTERISTICS BASED ON RP SURVEY

No.		Value
1	Average parking duration (hour)	1.94
2	Average parking cost (IDR)	1400
3	Existing and preferred parking location	Off-street
4	Average daily trip frequency	2.36
5	Average daily parking frequency	4.03
6	Average parking distance (m)	46.48
7	Average preferred parking distance (m)	45.15

B. Young Motorcyclist's Behaviors Toward Different Virtual Parking Schemes

To encourage young motorcyclists to use a safer transport mode like Trans Padang (a Bus Rapid Transit service managed by the local government in Padang, as depicted by Figure 15), the parking supply at schools and other premises could be limited. It could be combined with an expensive parking cost based on distance to the activity centers. Truong and Ngoc [51] suggested that public transport share could be increased using parking pricing. Thus, young motorists must find further and cheaper parking facilities from their destination [52]. Therefore, young motorcyclists must take a longer walk than the preferred distance of parking locations which is currently about 45.15m. This situation is believed and is expected to encourage them to change the mode from motorcycles to public transport services like Trans Padang.

Fig. 15 Trans Padang, a BRT service in Padang city

An SP survey was used to support this belief and expectation to assess the young motorcyclist's behaviors based on the RP survey results. The assessment was undertaken towards three virtual parking schemes described in Table 2. Different parking schemes should be applied for different trip makers as they might have different preferences regarding parking facilities, such as locations (on-street or off-street), pricing systems for parking (fixed or progressive), and parking safety and convenience facilities.

Firstly, the distribution of young motorcyclists towards each parking scheme and parking price is reported in Table 7. There are three parking price categories, namely (1) Parking price 1 (IDR3500), (2) Parking price 2 (IDR4000-IDR5000), and (3) Parking price 3 (≥IDR 5,000). It can be seen that parking price one is preferred by young motorcyclists over other prices for on-street parking. This parking price is selected by 73% and 59% for parking schemes 1 and 2, respectively. It sharply decreases to 23% once the parking price rises from IDR 3,500 to IDR 4,000-IDR 5,000 (parking price 2) for parking scheme 1. It is due to the lack of facilities available in this parking scheme which is considered important by young motorcyclists in selecting parking locations, as reported by Figures 9 and 10. At the same time, it is more costly than the previous one. However, about 40% of young motorcyclists remain with parking scheme two, although more expensive parking prices are applied.

This is to confirm that parking facilities such as on-site parking machines and parking ranger availability would affect the young motorcyclist's decision in choosing parking locations. Like parking scheme 1, the young motorcyclists tend to avoid parking along on-street once the parking price is higher than IDR 5,000 (parking price 3). Thus, it could be assumed that young motorists would pay the maximum parking price for on-street parking is about IDR5000.

These findings are significantly different compared to the passenger car (PC) users, as reported by Yaldi et al. [49]. The PC users are willing to pay the parking fee up to IDR 6,000 with percentages of 10%, 18% and 26% for parking schemes 1, 2 and 3, respectively. It may be related to the socio-economic characteristics of PC users, where all of them are employed with a certain amount of monthly income.

TABLE VII
YOUNG MOTORCYCLISTS PERCENTAGE FOR DIFFERENT PROPOSED PARKING SCHEMES

Scheme	% respondent <30'	(30-60)'	(60-120)'	(120-180)'	>180'	Total (%)
Scheme 1						
Parking price **1**	**7**	**15**	**23**	**5**	**23**	**73**
Parking price 2	2	6	9	3	7	27
Parking price 3	0	0	0	0	0	0
Scheme 2						
Parking price **1**	**6**	**11**	**16**	**4**	**22**	**59**
Parking price 2	3	10	15	4	8	40
Parking price 3	0	0	1	0	0	1
Scheme 3						
Parking price 1	3	7	8	2	12	33
Parking price **2**	**6**	**12**	**22**	**6**	**17**	**63**
Parking price 3	0	0	2	0	1	4

Parking price 1 (≤IDR 3,500), Parking price 2 (IDR 4,000-IDR 5,000), Parking price 3 (≥IDR 5,000)

Based on this finding, parking scheme 2, with parking prices up to IDR 5,000, could be expected to reduce parking usage by nearly 60%, as reported in Table 7. A higher parking fee would cause fewer young motorcyclists to use on-street parking. Thus, a reduction could also be expected in the young motorcyclist-related RTA. Further, more parking lots could

be considered for short-term parking (the maximum allowed parking duration is one hour), as suggested by Table 7.

However, it should be noted that this policy must be supported by all stakeholders, including by providing reliable Trans Padang services and serious law enforcement. In addition, the on-street parking should be equipped with adequate road lane widths as the on-street parking may interrupt the traffic flow, reduce the road capacity [41], and contribute to traffic congestion [40]. The nearest location of on-street parking to the activity centers should be longer than 40.15m, as indicated by Table 6. More parking lots are provided for short durations than longer ones.

Meanwhile, different behaviors are found for parking scheme three, as seen in Table 7. The young motorcyclists persist with this scheme although the parking fee increases to IDR 5,000. It sharply increases from 33% to 63% even though this parking scheme is more costly. This is also to confirm that facilities at the parking premises are considered important by young motorcyclists. This parking scheme offers additional parking facilities such as a parking operator CCTV camera near the activity centers, which is unavailable in parking schemes 1 and 2. Yet, the parking fee limit is found to be the same as in parking schemes 1 and 2 which are IDR 5,000.

Despite being more costly, these findings suggest that young motorcyclists preferred off-street parking over on-street parking and hence in line with the RP survey result as reported in Tables 3 and 4. Like parking scheme 2, more parking lots should be allocated for short-term parking as indicated by Tables 5 and 6 and Figure 11. Yet, this policy should be rigorously addressed since short-term parking could generate more impacts on road traffic than long-term ones [41].

The predicted reduction in off-street parking usage could reach 33% once parking scheme three is applied, with parking prices up to IDR 5,000. Parking scheme three could reduce a higher percentage of parking usage by young motorcyclists, as suggested by Table 7 and also supported by Tables 3 and 4, where young motorcyclists have a stronger desire for off-street parking than on-street parking.

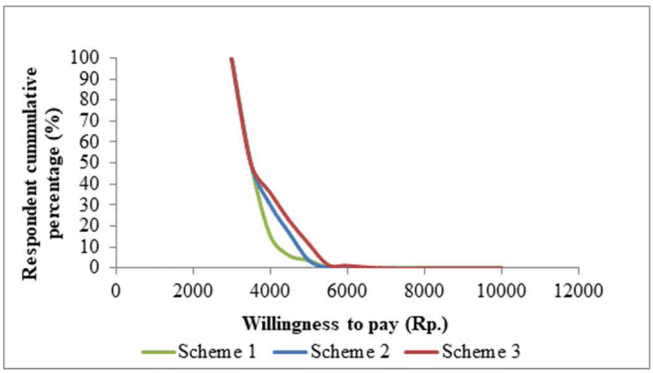

Fig. 16 WTP for young motorcyclists

Figure 16 illustrates the WTP for on-street and off-street parking belonging to young motorcyclists. The average WTP for parking schemes 1, 2, and 3 are IDR 3,373, IDR 3,509, and IDR 3,618, as displayed in Figure 17, which means more additional facilities provided at the parking premises would cause a higher number of young motorcyclists WTP. It also can be seen in Figure 16 that about 40% of young motorcyclists have a WTP less than IDR 4,000 for all parking schemes. Then, it varies between IDR 4,000 to IDR 6,000, where the lowest WTP belongs to parking scheme 1. Young motorcyclist tends to pay more for off-street parking than on-street parking.

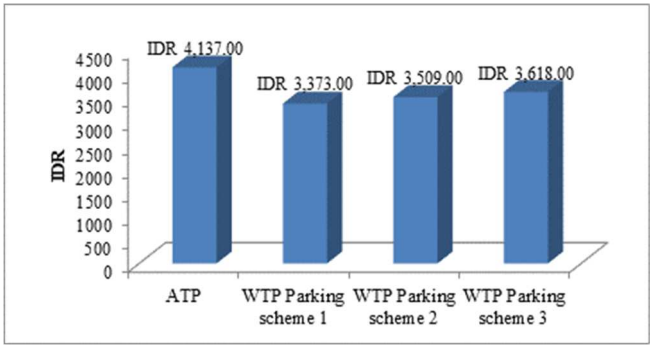

Fig. 17 Average ATP and WTP for young motorcyclists

Figure 18 shows the ATP for parking fees belongs to young motorcyclists. The average ATP for parking fee is about IDR 4,100, significantly higher than the average parking fee found by the RP survey and higher than the WTP for all parking schemes (see Figure 19). About 70% of young motorcyclists have the same ATP as the average. It could be predicted that the young motorist ATP for paid parking facilities is higher than the highest WTP for parking scheme 3.

These findings could be proposed to and used by the road authority in defining future parking policies to control motorcycle usage by young motorcyclists, resulting in the declining number of young motorcyclist-related RTA. Thus, the proposed parking schemes and their attributes to reduce motorcycle usage and decrease RTA by young motorcyclists found by this study are summarized in Table 8.

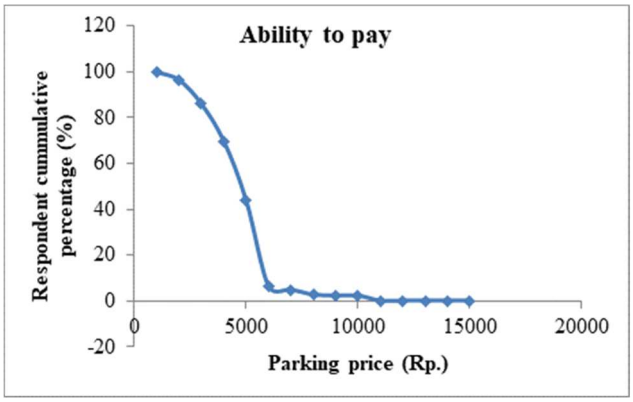

Fig. 18 ATP for young motorcyclists

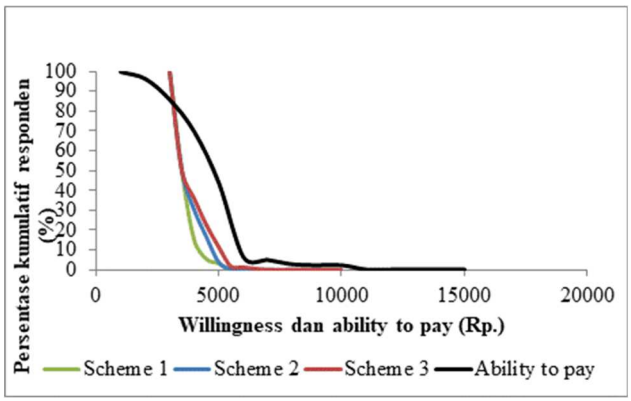

Fig. 19 WTP and ATP for young motorcyclists

TABLE VIII
THE PROPOSED PARKING CHARACTERISTICS FOR PARKING CONTROL AND MANAGEMENT SCHEMES

Parking location	On-street parking	Off-street parking
Price Scheme	Progressive pricing	Progressive pricing
Based on parking price (IDR/hour)	5,000	5,000
Parking distance-activity center (m)	>50	>50
Provided parking lots (%) *		
- Short-term (60 minutes)	>30	>29
- 60-120 minutes	<39	<38
- >120 minutes	<30	<30
Future parking development locations	√	

* On-street Short-term parking lots should be allocated based on the road capacity

IV. CONCLUSION

Findings from this study suggest that the number of young motorcyclists could be decreased by applying appropriate parking scheme policies. It includes providing parking facilities located further than the preferred young motorcyclist distance between parking premises and activity centers which is currently less than 50 meters. The average WTP for proposed parking schemes are IDR 3,373, IDR 3,509, and IDR 3,618 for schemes 1, 2 and 3 consecutively, while the average ATP is found to be much higher, which is IDR 4,100. Thus, paid parking facilities should be provided with a progressive pricing system where the minimum base fee is above IDR 5,000. Next, more parking lots should be allocated for short-term parking where the minimum percentage is 30% of total parking lots.

Although the off-street parking scheme could encourage young motorcyclists to switch to a safer transport mode like the Trans Padang service, the on-street parking scheme seems to have a higher potential in reducing motorcyclist numbers since it would have a longer distance to the activity center compared to the off-street ones like front school yards. However, using road spaces for parking could impact the adjacent road capacity and cause congestion. Therefore, on-street parking could be applied after ensuring the designated road has sufficient capacity. Otherwise, off-street parking should be used.

Finally, it should be noted that the road authority could control motorcycle usage by young motorcyclists not only by using parking controls but also by providing reliable public transport services based on the young motorcyclist's needs, serious law enforcement, and support the society. Therefore, further research would be directed to analyzing the public transport service attributes based on the young road user desires and hence could attract more young motorcyclists to use public transport instead of motorcycles.

NOMENCLATURE

ATP	Ability to Pay	IDR
CBD	Central Business District	
GDP	Gross Domestic Product	
IDR	Indonesian Rupiah	
Km	Kilometer	
M	Meter	
MC	Motorcycle	
PC	Passenger Car	
RP	Revealed Preference	
RTA	Road Traffic Accident	
SP	Stated Preference	
USD	United States Dollar	
WHO	World Health Organization	
WTP	Willingness to Pay	IDR

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