Motorcycle accident has become a major public health problem worldwide. Each year, every country encountered the loss of valuable human resource, a large sum of assets, socioeconomics well-being, and ultimately people’s quality of life. In 2015, based on the survey data of the World Health Organization (WHO), there were approximately 1.25 million deaths and 20 – 50 disability cases according to road traffic accidents annually.1 In South and East Asia, mortality rate of road traffic accident was about 17 per 100,000 populations.

In Thailand, road traffic accidents in 2014 as estimated by the WHO was the second most in the world with 24,237 deaths or 22.4 deaths per 100,000 population. It was also estimated that there were 107,123 accident cases hospitalized averaged as 40 deaths per day or 2 per hour.

It was also found high in provinces with a large number of industrial plants. In addition, rate of road traffic accidents was estimated that there were 17 per 100,000 populations, which could be found high in provinces with a large number of industrial plants.
such as Prachinburi, Chachoengsao and Rayong. Especially in
the industrial area, among all road traffic accident incidents,
45.0% were of motorcycles, 42.3% of cars and 12.7% of
trucks. These road traffic accidents caused the loss of life and
assets both at individuals and society as a whole.

Based on the national injury surveillance system in 2013,
motorcycles were the leading cause of injury (83.20%),
followed by cars (6.56%) and bicycles and tricycles (2.94%).
Among those motorcycle riders not wearing helmets while
having accidents, 87.32% experienced severe injury. Such
severe injuries were found in 86.13% of riders themselves and
93.96% of the passengers. Furthermore, based on the data
of injuries and deaths relating to motorcycles in all age ranges,
individuals aged 15 – 19 years old were found the most.
Most severe injuries were found in those not wearing helmet. In
2014, the surveillance network for road safety called “Road
Safety Watch” reported that helmet was worn in only 24% of
those teenagers experiencing road traffic accidents.
Regarding age groups, individuals aged 15 - 19 years were
the most likely to face road traffic accidents; while their
younger (10 – 14 years) and older (20 – 24 years)
counterparts were less likely. All three age groups combined
were accounted for 35% of road traffic accidents. These
findings indicated that road traffic accidents have been a major
cause of death among teenagers, especially those in senior
high schools (age of 15 – 19 years old).

In Phitsanulok province, road traffic accident has always
been the third leading cause of death in the last three years
from 2016 to 2018 with 261, 229 and 303 deaths,
respectively. Those death cases could be viewed as rates of
29.82, 26.00 and 34.27 per 100,000 populations, respectively.
Economic burden on families and society as a whole has been
increasing since road traffic accident cases with disabilities
could lead to both immense direct and indirect medical costs.
In the fiscal year of 2016, which was from October 1, 2015 to
September 30, 2016, a total of 280 deaths relating to road
traffic accidents were reported in Phitsanulok. More than half
of these death cases were found in the Muang district and as
high as 63.14% were dead at the accident spot. These
indicated severe road traffic accidents especially around
newyear’s eve where more accidents cases occurred with 8
deaths and 416 injuries in 2014, 5 deaths and 210 injuries in
2015, and 5 deaths and 345 injuries in 2016. This ascending
trend of road traffic accident injuries is of a great concern by
Phitsanulok Provincial Public Health Administration Office and
measures to prevent and alleviate the injuries have been
continuously enforced.

A study by Boonprasom and Petpoom found that
motorcycle accident preventing behavior among grade 1 – 6
highs school students was at a moderate level; while
perceived risk of accident, knowledge about traffic laws, and
male gender were significant predicting factors for the
behavior (P-value < 0.05). Based on the report of the Office
of Non-communicable Diseases, causes of motorcycle
accidents included driving over speed limit and driving under
the influence. The study of Jarumanee revealed that factors
influencing road accidents included noncompliance or violation
of traffic rules, a lack of driving skill, vehicle defects, poor
traffic surface, a visibility block on traffic signs and/or low
visibility, and disrupted law enforcement. With all problems,
studies to prevent motorcycle accidents and factors
influencing such accidents are of an urgent need.

In Muang district of Phitsanulok province, the area around
Buddhachinnarat High School surrounded by markets is
congested with vehicles. Students are dropped off from and
picked up onto the car by their parents. In addition, the railroad
in front of the school makes the traffic even worse and more
road traffic accidents have been observed. With a unique
circumstance of road traffic accidents among teenagers and
the surrounding, we aimed to determine factors affecting
motorcycle accident preventing behaviors of students in
Buddhachinnarat High School, Muang district, Phitsanulok
province. The study conceptual framework was guided by the
Health Belief Model.

Based on the Health Belief Model, the practice of
desirable behavior is influenced by various factors. Based on
perceived susceptibility or risk, individuals will perform the
desirable behavior if they adequately perceive that their poor
behavior makes them susceptible to the illness or undesirable
health outcomes. Perceived severity of the potential poor
health or illness could also make individuals more prone to
adopting the desirable behavior. At the same time, if
perceived benefits outweigh perceived barriers of
performing the desirable behavior, individuals are more likely
adopt the behavior. In this present study, the desirable
behavior was motorcycle accident prevention, while proposed
predictive factors included perceived severity of road traffic
accident, perceived benefits of road traffic accident
prevention, and perceived barriers of road traffic accident
prevention.
Specifically, the objectives of the study were to determine 1) levels of motorcycle accident preventing behaviors of students in Buddachin narat High School, Muang district, Phitsanulok province, and 2) factors that affect such behaviors among the students. We hypothesized that motorcycle accident preventing behaviors among students in Buddachin narat High School were associated with demographic characteristics (gender, age, and education level), having a driving license for motorcycle, experience in motorcycle riding in years, helmet wearing, having motorcycle accident, knowledge about laws and regulations regarding road traffic, perceived risk or susceptibility of road traffic accident, perceived severity of road traffic accident, perceived benefits of road traffic accident prevention, and perceived barriers or obstacles of road traffic accident prevention.

Methods

In this predictive research, factors potentially affecting levels of motorcycle accident preventing behaviors of senior high school students in Buddachin narat High School, Muang district, Phitsanulok province were examined. The study survey was conducted from June to September 2019. Study population was 648 senior high school students (i.e., grades 4, 5 and 6) of Buddachin narat High School, Muang district, Phitsanulok province in the academic year of 2018. Twelve factors hypothesized to relate with motorcycle accident preventing behaviors included gender, age, education level, having a driving license for motorcycle, experience in motorcycle riding in years, helmet wearing, having motorcycle accident, knowledge about laws and regulations regarding road traffic, perceived risk or susceptibility of road traffic accident, perceived severity of road traffic accident, perceived benefits of road traffic accident prevention, and perceived barriers or obstacles of road traffic accident prevention. Based on the equation of Chirawatkul, with a total of 12 variables examined and 20 subjects needed for each variable, a sample size of 241 participants was required. Participants were selected by a systematic random sampling with a sampling interval of 3.

Research instruments

The study instrument was a 4-section questionnaire which was modified by the researchers from the work of Thongroang. The questionnaire was self-administered and took about 20 minutes to complete. The first section collected demographic information of the participants (gender, age, education level, having motorcycle driving license, experience as number of years of motorcycle riding, helmet wearing, and history of motorcycle accidents). The second section asked about knowledge on traffic laws and regulations (16 items). One point was scored for a correct answer while 0 for an incorrect one. With a possible total score of 16 points, three levels of traffic laws knowledge were categorized as low (0 – 9 points), moderate (10 – 13 points), and high (14 – 16 points).

As guided by the Health Belief Model, the third section evaluated the participants about their perception on risk and severity of road traffic accidents (12 and 6 items, respectively), and benefits and obstacles of road traffic accident prevention (8 and 9 items, respectively). Response for this section was a 5-point Likert-type rating scale ranging from 1-least agreed to 5-most agreed, with reverse scores for negative statements. The total score of each of the four parts of the third section was categorized into three levels: 12 – 27, 28 – 44, and 45 – 60 points for low, moderate and high level of perceived risk of road traffic accidents, respectively; 6 – 13, 14 – 21, and 22 – 30 points for low, moderate and high level of perceived severity of road traffic accidents, respectively; 8 – 18, 19 – 29, and 30 – 40 points for low, moderate and high level of perceived benefits of road traffic accident prevention, respectively; and 9 – 20, 21 – 32, and 33 – 45 points for low, moderate and high level of perceived obstacles of road traffic accident prevention, respectively.

The last section assessed the participant’s motorcycle accident preventing behaviors (18 items). Response for this section was a 4-point Likert-type rating scale ranging from 1-never practice to 4-practice regularly, with reverse scores for negative behaviors. With the total score of 73 points, three levels of behavior were categorized as low, moderate and high (18 – 35, 36 – 53, and 54 – 73 points, respectively).

Instrument quality assurance

Content validity of the questionnaire was examined by three experts using the Item Objective Congruence Index (IOC) of 0.66 – 1.00 as the acceptability criteria. Once found acceptable after revisions, the questionnaire was tested for internal consistency reliability with 30 individuals with characteristics comparable to the prospective participants. For the section on knowledge of road traffic laws and regulations, reliability was found high with Kuder-Richardson’s coefficient.
of 0.87 and difficulty level was moderate with values for all items in a range of 0.53 – 0.73. Internal consistency reliability for the third and fourth sections was found high with Cronbach’s alpha coefficients of 0.86 and 0.78, respectively.

**Participant’s right protection**

The study protocol was approved by the Ethics Committee for Human Studies of Pibulsongkram Rajabhat University (approval number: EC No. 2018/002) Participants were provided with study objectives and steps. With the voluntary nature of the study, participants were informed that they could withdraw from the study at any time point with no adverse consequence. Their answers and information were secured and presented as summary results, not individual participant’s data, and only for educational purpose. Written informed consent was obtained as a proof of voluntary participation.

**Data collection procedure**

Permission to conduct a survey at Buddhachinnarat High School was formally requested to the school director. Once approved, the researchers approached the prospective students identified by the systematic sampling method. The investigator (NS) introduced himself to the students and informed them about the study objectives and steps of the study. Once informed consent was obtained, participants were asked to complete the questionnaire. Once completed, the researcher inspected the questionnaire for any incomplete answers and correct according.

**Statistical analysis**

Descriptive statistics including frequency with percentage, mean with standard deviation, and maximum and minimum values were used for demographic characteristics and scores of knowledge, perceptions based on the Health Belief Model, and motorcycle accident preventing behaviors. To test the association between the behavior score and potential affecting factors, stepwise multiple regression analysis was conducted.

All statistical significance was set at a type I error or 5% (or P-value < 0.05). Statistical software program SPSS version 17 was used for analysis. All assumptions of multiple regression analysis were met.

Of the 241 participating students, there were more female than male participants (64.32% and 35.68 %, respectively) (Table 1). The majority were 17 years old (34.02 %), followed by 16 (31.54 %), 18 (19.09 %), 15 (13.28 %) and 19 years old (2.07%). With the sampling method, numbers of participants in each grade were relatively evenly distributed (33.20 %, 32.78 % and 34.02 %, for grades 4, 5 and 6, respectively). Almost two-thirds had no motorcycle driving license (63.49 %); while 36.51 % did. The majority had 1 – 3 years of motorcycle riding experience (39.42 %), followed by 4 – 6 years (28.22 %) and no experience (25.72 %). Almost all of them wore helmet (96.27 %) and had no accidents (89.21 %).

**Table 1** Demographic characteristics and motorcycle accident experience of the participants (N = 241).

<table>
<thead>
<tr>
<th>Characteristics and experiences</th>
<th>N</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Age (years)</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>15</td>
<td>32</td>
<td>13.28</td>
</tr>
<tr>
<td>16</td>
<td>76</td>
<td>31.54</td>
</tr>
<tr>
<td>17</td>
<td>82</td>
<td>34.02</td>
</tr>
<tr>
<td>18</td>
<td>46</td>
<td>19.09</td>
</tr>
<tr>
<td>19</td>
<td>5</td>
<td>2.07</td>
</tr>
<tr>
<td>Mean = 16.65, S.D. = 1.002, min = 15, max = 19</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Gender</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>86</td>
<td>35.68</td>
</tr>
<tr>
<td>Female</td>
<td>155</td>
<td>64.32</td>
</tr>
<tr>
<td><strong>Education level</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>High school grade 4</td>
<td>80</td>
<td>33.20</td>
</tr>
<tr>
<td>High school grade 5</td>
<td>79</td>
<td>32.78</td>
</tr>
<tr>
<td>High school grade 6</td>
<td>82</td>
<td>34.02</td>
</tr>
<tr>
<td><strong>Having a driving license for motorcycle</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>88</td>
<td>36.51</td>
</tr>
<tr>
<td>No</td>
<td>153</td>
<td>63.49</td>
</tr>
<tr>
<td><strong>Experience in motorcycle riding (years)</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>None</td>
<td>62</td>
<td>26.72</td>
</tr>
<tr>
<td>1 – 3 years</td>
<td>95</td>
<td>39.42</td>
</tr>
<tr>
<td>4 – 6 years</td>
<td>68</td>
<td>28.22</td>
</tr>
<tr>
<td>7 – 10 years</td>
<td>16</td>
<td>6.64</td>
</tr>
<tr>
<td><strong>Helmet wearing</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>232</td>
<td>96.27</td>
</tr>
<tr>
<td>No</td>
<td>9</td>
<td>3.73</td>
</tr>
<tr>
<td><strong>Having motorcycle accident</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>No</td>
<td>215</td>
<td>89.21</td>
</tr>
<tr>
<td>Yes</td>
<td>26</td>
<td>10.79</td>
</tr>
</tbody>
</table>

**Level of each study variable**

It was found that all of the participants had a high level of knowledge about laws and regulations regarding road traffic (100.0 %) (Table 2). Based on the Health Belief Model, majority of the participants had a moderate level of perceived risk of road traffic accident (66.4 %), followed by those with high and low levels (32.0 % and 10.7 %, respectively). About
two-thirds had a high level of perceived severity of road traffic accident (69.63%), followed those with moderate and low levels (30.3% and 0.4%, respectively). For the perceived benefits of road traffic accident prevention, slightly more than half of the participants rated their opinion at a moderate level (56.8%); while 42.3% provided a high level and 0.8% rated it at a low level. Almost two-thirds of the participants had a low level of perceived obstacles of road traffic accident prevention (63.5%) followed by those with moderate (27.0%) and high levels (9.5%). The majority of participants had a moderate level of motorcycle accident preventing behaviors (78.8%), followed by those with high and low levels (10.8% and 10.4%, respectively) (Table 2).

### Table 2
Levels of study factors (N = 241).

<table>
<thead>
<tr>
<th>Factors</th>
<th>N</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Knowledge about laws and regulations regarding road traffic</td>
<td>241</td>
<td>100.0</td>
</tr>
<tr>
<td>High</td>
<td>241</td>
<td>100.0</td>
</tr>
<tr>
<td>Moderate</td>
<td>0</td>
<td>0.0</td>
</tr>
<tr>
<td>Low</td>
<td>0</td>
<td>0.0</td>
</tr>
<tr>
<td>Perceived risk of road traffic accident</td>
<td></td>
<td></td>
</tr>
<tr>
<td>High</td>
<td>77</td>
<td>32.0</td>
</tr>
<tr>
<td>Moderate</td>
<td>160</td>
<td>66.4</td>
</tr>
<tr>
<td>Low</td>
<td>4</td>
<td>1.6</td>
</tr>
<tr>
<td>Perceived severity of road traffic accident</td>
<td></td>
<td></td>
</tr>
<tr>
<td>High</td>
<td>167</td>
<td>69.3</td>
</tr>
<tr>
<td>Moderate</td>
<td>73</td>
<td>30.3</td>
</tr>
<tr>
<td>Low</td>
<td>1</td>
<td>0.4</td>
</tr>
<tr>
<td>Perceived benefits of road traffic accident prevention</td>
<td></td>
<td></td>
</tr>
<tr>
<td>High</td>
<td>102</td>
<td>42.4</td>
</tr>
<tr>
<td>Moderate</td>
<td>137</td>
<td>56.8</td>
</tr>
<tr>
<td>Low</td>
<td>2</td>
<td>0.8</td>
</tr>
<tr>
<td>Perceived obstacles of road traffic accident prevention</td>
<td></td>
<td></td>
</tr>
<tr>
<td>High</td>
<td>23</td>
<td>9.5</td>
</tr>
<tr>
<td>Moderate</td>
<td>65</td>
<td>27.0</td>
</tr>
<tr>
<td>Low</td>
<td>153</td>
<td>63.5</td>
</tr>
<tr>
<td>Motorcycle accident preventing behaviors</td>
<td></td>
<td></td>
</tr>
<tr>
<td>High</td>
<td>26</td>
<td>10.8</td>
</tr>
<tr>
<td>Moderate</td>
<td>190</td>
<td>78.8</td>
</tr>
<tr>
<td>Low</td>
<td>25</td>
<td>10.4</td>
</tr>
</tbody>
</table>

Predicting factors of motorcycle accident preventing behaviors

Based on the regression standardized regression coefficients (β) in a descending order, significant predictors of the motorcycle accident preventing behaviors included perceived obstacles of road traffic accident prevention (X₁₃), having motorcycle driving license (X₅), perceived risk of road traffic accident (X₁₀), and age (X₁) (Table 3). With all four predictors together, a correlation coefficient (R) of 0.638 indicated a 39.8% of the behavior variance explained (R² = 0.398) with statistical significance (P-value < 0.05). The equation to predict motorcycle accident preventing behaviors by the unstandardized stepwise regression coefficients (β) could be depicted as follows.

\[ Y' = 33.711 - 0.454(X_{13}) + 5.833(X₅) + 0.353(X_{10}) + 0.949(X₁), \]

where

- \( Y' \) = score of motorcycle accident preventing behaviors,
- \( X_{13} \) = score of perceived obstacles of road traffic accident prevention,
- \( X₅ \) = having motorcycle driving license,
- \( X_{10} \) = score of perceived risk of road traffic accident, and
- \( X₁ \) = age in years.

Hence, the score of motorcycle accident preventing behaviors decreased with the increase in score of perceived obstacles of road traffic accident prevention. On the other hand, the behavior score increased with having motorcycle driving license and increase in the score of perceived risk of road traffic accident and age (Table 3).

### Table 3
Predictive factors of motorcycle accident preventing behaviors based on stepwise multiple regression (N = 241).

<table>
<thead>
<tr>
<th>Predictive factors</th>
<th>B</th>
<th>SE₂β</th>
<th>β</th>
<th>t</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>perceived obstacles of road traffic accident prevention</td>
<td>0.454</td>
<td>0.053</td>
<td>0.443</td>
<td>8.523</td>
<td>&lt; 0.001</td>
</tr>
<tr>
<td>having motorcycle driving license (X₅)</td>
<td>5.833</td>
<td>0.955</td>
<td>0.313</td>
<td>6.110</td>
<td>&lt; 0.001</td>
</tr>
<tr>
<td>perceived risk of road traffic accident (X₁₀)</td>
<td>0.353</td>
<td>0.084</td>
<td>0.224</td>
<td>4.215</td>
<td>&lt; 0.001</td>
</tr>
<tr>
<td>age (X₁)</td>
<td>-0.949</td>
<td>0.464</td>
<td>-0.206</td>
<td>0.423</td>
<td>0.042</td>
</tr>
</tbody>
</table>

Note: ANOVA model: covariate \( x \) = 33.711, R = 0.638, R² = 0.403. Adjusted R² = 0.398, F = 1.982

### Discussions and Conclusion

Among senior high school students in Buddhachininnarat High School, Muang district, Phitsanulok province, our study found four significant predictors of the motorcycle accident preventing behaviors including age, having motorcycle driving license, perceived risk of road traffic accident, and perceived obstacles of road traffic accident prevention. The score of motorcycle accident preventing behaviors decreased with the increase in score of perceived obstacles of road traffic accident prevention. On the other hand, the behavior score increased with having motorcycle driving license and increase in the score of perceived risk of road traffic accident and age. The discussions were as follows.

Perceived obstacles of road traffic accident prevention was significantly associated with the motorcycle accident...
Perceived obstacles to driving behavior modification could cause difficulties and/or inconvenience in daily life which could further affect the change in the actual accident preventing behavior. Our finding was consistent with the study of Upathump۸ where those with no motorcycle related injuries had a lower level of perceived obstacles of safe motorcycle driving behaviors compared with those with injuries.

We found that having a motorcycle driving license was associated with a higher score of the motorcycle accident preventing behaviors. This could be due to the fact that to obtain driving license, one needs to attend the short-course training, pass the paper examination, and pass the actual driving test. ۹ This requirement forces the driving license holders to have more knowledge and awareness in their actual driving than those having no license. However, the study of Upathump examined the perceived benefits, perceived obstacles, and perceived self-efficacy in relation to safe driving behaviors among those with and without motorcycle related injuries in tertiary care hospitals in the south of Thailand and found that students had similar motorcycle driving behaviors regardless of driving license holding status. ۸

Perceived risk of road traffic accident was predictive for the motorcycle accident preventing behaviors in our study. This perceived risk of accident is an acquired perception of the driver on an involvement in and the anxiety on encountering a foreseeable accident. This was consistent with the concept of the Health Belief Model. ۵ Perceived risk of road traffic accident or related injuries reflects the drivers’ capacity to estimate the risk in a given traffic circumstance and to prevent themselves from the injuries. This capacity reduces the risky driving behavior. Drivers with poor perceived risk of road accident are prone to reckless driving and subsequent road accidents. A study also showed that perceived risk of road accident could predict motorcycle accident preventing behavior among high school students (grade 1 – 6) with statistical significance (P-value < 0.05). ۷ It was also consistent with the study of Yingratanasuk et al where perceived risk of motorcycle accident was associated with the safe road traffic behavior with statistical significance (P-value < 0.05) among students and staff at Bhurapa University. ۱۰ The study of Leelawiwat also showed that perceived risk of motorcycle accident was predictive for motorcycle accident preventing behavior among high school students with statistical significance (P-value < 0.05). ۱۱

Age was significantly associated with the motorcycle accident preventing behaviors among these senior high school students as hypothesized. Age is an influencing factor of given behaviors since all behaviors are related with past experience. The greater the age, the better decision for self-care is made. This is based on the Health Belief Mode ۵ that age is a modifying factor which has its indirect effect through the person’s perception. In addition, based on Orem’s concept, age is related to development and past experience which could result in differences in individuals' expressing, handling, understanding, reasoning and making decision on their behaviors. ۱۲ In short, the more maturity, the better choice selection and decision making. Our finding was also consistent with the work of Jongkae et al were they found that older teenagers were more likely to have a better behavior of motorcycle accident prevention than their younger peers. ۱۳ However, our result was in contrast to the study of Boonprason and Phethum ۳ of which age was not associated with motorcycle accident prevention behavior among grade 1 – 6 high school students at a tutorial school in Phitsanulok.

Other factors were not significantly associated with the motorcycle accident preventing behavior among senior high school students. These included gender, education level, experience in riding motorcycle, wearing helmet, experience in motorcycle accident, knowledge about laws and regulations on traffic, perceived severity of the accident, and perceived benefits of accident preventing behavior. However, in few other studies, knowledge about laws and regulations on traffic, gender, experience in motorcycle riding, and experience in motorcycle accident were significantly predictive for accident preventing behavior. ۳، ۱۲

Our findings could be used for public policy making. All involving parties such as department of road transportation and public health offices could cooperate in initiating campaign or program to promote awareness among high school students about road accident and compliance with traffic laws and regulations. In terms of future research, studies on student’s participation on motorcycle accident preventing behavior modification with social support should be conducted. Monitoring factors potentially causing motorcycle accidents should also be studied.

In conclusion, age, having motorcycle driving license, perceived risk of road accident, and perceived obstacles of road traffic accident prevention were significantly predictive for
motorcycle accident preventing behavior among senior high school students.

Acknowledgement

The authors would like to thank all participants for their invaluable contribution. Great gratitude was also extended to all high school students in Buddhachinarajpittaya School, Muang district, Phitsanulok province for their kind assistance and support.

References


