The Development of Motorcycle Accident Models Based on Riders’ Characters

Margareth Evelyn Bolla 1*, Ludfi Djakfar 2, Achmad Wicaksono 2, Cleoputri Al Yusainy 3

1 Department of Civil Engineering, Faculty of Science and Engineering, Nusa Cendana University, Kupang, Indonesia.
2 Department of Civil Engineering, Faculty of Engineering, Brawijaya University, Malang, Indonesia
3 Department of Psychology, Faculty of Social and Political Sciences, Brawijaya University, Malang, Indonesia

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Abstract

Human errors have commonly been perceived as the dominant cause of accidents. Different individuals may behave differently towards certain situations, leading to accidents. This study aims to model the relationship between the riders’ personalities, riding performance, and the probability of being involved in an accident. Adding mindfulness as a mediating variable and demographic factors as moderating variables are also essential points to developing the model. The Big Five Inventory (BFI) and Mindful Attention Awareness Scale (MAAS) were used to measure the respondents’ traits, while the Honda Riding Trainer (HRT) was used as a simulation tool. The Structural Equation Modelling (SEM) analysis shows that only the neuroticism variable significantly predicts mindfulness and riding performance. The openness and conscientiousness variables only significantly predicted mindfulness, while agreeableness is the only Big Five personality that significantly predicted riding performance. The results also show that although the mindfulness (M) variable in this study has not been able to become a mediating variable, it is strong enough as an exogenous variable for riding performance. The logistic regression analysis found that the worse the rider’s performance, the greater the chance of an accident. Female riders are more than twice as likely to have an accident as male riders. These results indicate the need to research road safety that is differentiated by sex and its characteristics based on it.

Keywords: Big Five Personality; Riding Simulator; Mindfulness; Mediating Variable; Moderating Variable.

1. Introduction

A global status report on road safety [1] shows that traffic accidents are still a severe problem worldwide. Even in the COVID-19 pandemic, the reduction in the accident fatality rate was only 8%, not as expected [2]. Worldwide, pedestrians and motorcyclists account for 28 percent of all deaths [3]. The same problem can also be found in Indonesia, which ranks third in Asia for the highest number of deaths due to traffic accidents. In fact, according to the WHO, when viewed from the statistical percentage of the population, Indonesia ranks first with a death rate due to traffic accidents of 0.015% of the total population, and most of the victims are motorcyclists. Based on data from the Central Statistics Agency (BPS) of Indonesia, from 2020 to 2022, after the pandemic, Indonesia experienced an
increase in traffic accidents and reached 103,645 incidents in 2021. In 2022, the number of fatalities in road traffic accidents in Indonesia was approximately 27,533 thousand, indicating an increase compared to the previous year [4]. Indonesia is one of the Association of Southeast Asian Nations (ASEAN) countries that has a relatively high death rate due to driving accidents on the road.

The fact that motorcycle accidents are the type of accident with the largest proportion, dominated by human factors as the cause of accidents, becomes the basis for thinking in this study. Humans as drivers have factors that influence driving behavior, namely, physiological factors related to the condition of the human body, such as the nervous system, sight, hearing, and other senses, as well as psychological factors, which include motivation, intelligence, experience, emotions, maturity, and habits.

Previous studies related to human factors as the cause of accidents have focused on demographic aspects such as gender, age, education level, and occupation [5–7]. Although the studies provide essential information, they must also provide good insights into aspects of riders' behavior that affect road safety [8]. However, the demographic variables studied have great potential as moderator variables [9, 10]. The variables are not the target of intervention in safety action programs. Different individuals may behave differently towards certain situations, which may be due to individual personality traits leading to accidents [11].

In psychology, personality has been modeled and grouped theoretically to describe individual characteristics that distinguish them from others. One such personality model is the Big Five, which was introduced by Goldberg in 1981. The Big Five theory is the most researched and used personality theory from the late 1980s to the present. The development of a personality taxonomy simplifies thousands of traits into five personality dimensions. The popular acronym for the Big Five is OCEAN, which are Openness, Conscientiousness, Extraversion, Agreeableness, and Neuroticism. The Big Five approach to personality is mainly based on research rather than theory; in other words, it is an inductive approach to personality in which the theory is generated from data [12]. These five dimensions do not provide completely exhaustive explanations of personality, but they are known as the Big Five because they encompass a large portion of personality-related terms. Each of the Big Five personality dimensions has several examples of traits that describe some characteristics of each trait based on high and low scores, as presented in Table 1 [13]:

<table>
<thead>
<tr>
<th>Trait Scales</th>
<th>Low Scores</th>
<th>High Scores</th>
</tr>
</thead>
<tbody>
<tr>
<td>Extraversion</td>
<td>Optimistic, Easily Adapts to the Environment, Active, Talkative, Full of Affection.</td>
<td>Less Friendly, Authoritative, Likes to Be Alone, Task-Oriented, Quiet.</td>
</tr>
<tr>
<td>Openness</td>
<td>Curious, Broad Interest, Creative, Original, Imaginative, Untraditional.</td>
<td>Conventional, Simple, Narrow Interests, Unartistic, Closed, Conservative.</td>
</tr>
<tr>
<td>Agreeableness</td>
<td>Gentle, Trusting Others, Helpful, Forging, Obedient.</td>
<td>Cynical, Rude, Suspicious, Uncooperative, Vindictive, Mean, Manipulative.</td>
</tr>
</tbody>
</table>

Previous research [14] discovered that certain elements of the Big Five dimensions, including altruism representing agreeableness, anxiety representing neuroticism, and sensation-seeking representing extraversion, could predict both mediating and endogenous variables. This suggests that personality traits influence risky driving behavior through their impact on attitudes that dictate driver behavior.

One concept considered to have important implications for the structure of human personality that helps a person train his attention and focus on wandering thoughts is mindfulness [15]. Mindfulness, rooted in the contemplative tradition of Buddhist beliefs [16], has been widely used in studying drivers and their behavior on the road [17]. Mindfulness has been proven effective as a person-oriented emotion regulation strategy to strengthen the individual's self-control capacity [18]. Emotion regulation can be understood as a process of intervention in emotional experiences that is useful for producing appropriate emotional responses, such as neutralizing negative emotions in the form of anger, which significantly increases the risk of increasing driving speed [19]. Mindfulness can be interpreted in two forms: a trait [20] and a state [21]. It can also be interpreted as a set of skills composed of traits and states that could be enhanced. In its position as a trait and state, mindfulness needs further investigation regarding its role in transportation safety. The potential of mindfulness as a mediating variable has been researched to see its usefulness in positive daily behavior [21, 22]. It gives a space that supports mindfulness training to be used as a therapy for motorcyclists in intervening with personality interventions [23, 24].

Research on how the psychological elements of a driver affect safe driving behavior on the road is constantly evolving. Investigating how driving performance directly impacts the probability of traffic accidents is essential. Much research has been carried out on driving performance for the development of four-wheeled vehicles, but the driving
performance of two-wheeled vehicle drivers, who require higher driving performance when driving than four-wheeled vehicle drivers, has yet to be studied in detail. One study that tried to quantify motorbike driving performance concerning the possibility of a collision was conducted by researchers from the Japan Automobile Research Institute [25]. In their research, riding simulators were used to investigate riding behavior. Several studies using the Honda Riding Trainer (HRT) simulation tool have been carried out to build a behavioral model of at-risk motorcyclists [26]. The use of HRT was found to reduce the number of accidents in a virtual environment due to increased hazard perception skills [27]. As a motorcycle riding simulation tool, it is also beneficial for psychophysical measurements [28].

The relationship between personality, riding behavior, and accident probability has been widely studied [29–31]; however, there is no clear pattern that describes how the overall dimensions of the Big Five personality affect the riders' performance using the Honda Riding Trainer (HRT) simulation tool. This study aims to produce a comprehensive model for describing the relationship between the personality of a motorcyclist, riding performance, and the probability of being involved in an accident. The addition of mindfulness as a mediating variable and demographic factors as moderating variables are also essential points in this study to complete the model to be developed.

2. Material and Methods

2.1. Participants

Data collection was carried out in Surabaya and Malang City, which represent East Java Province, Indonesia. As of October 2022, the province had the highest accident rate in Indonesia [32]. Since the HRT equipment belongs to PT Astra Honda Motor (AHM), data collection was carried out at PT AHM dealers by taking respondents from people who came to these dealers. Sampling was conducted on people who met the requirements needed in this study, namely, age > 18 years, having an active motorcycle license, and having experience riding a motorcycle for more than one year. The total number of respondents was 415, but 19 did not complete the questionnaire, so they were excluded from the analysis, leaving 396 respondents.

2.2. Measures and Procedures

This study used the Big Five Inventory (BFI) and Mindful Attention Awareness Scale (MAAS) questionnaires as personality measures. The BFI scale consists of 28 indicators that have previously been adapted into Indonesian and have been tested for validity and reliability [33], while the MAAS scale (Brown & Ryan, 2003), which consists of 15 indicators, is a scale that has also been adapted to Indonesia [34]. Both questionnaires use a Likert scale, where the BFI uses a 7-point Likert scale from "strongly agree," which is valued at 1, to "strongly disagree," which is valued at 7. The MAAS questionnaire uses 6 points from "almost always," which is valued at 1, until "very rarely," which is valued at 6. The BFI value is calculated by scaling and scoring [35], where the smallest value indicates the most dominant character of the respondents.

The HRT simulator is the tool chosen to represent the actual situation on the highway. Research has shown that driving simulators have proven to be excellent practical educational tools and are effective in training all motorists in safe driving techniques [25, 26, 36]. As shown in Figure 1, this motorcycle simulator is like a computer game, consisting of a computer with software, motorcycle handlebars, transmission pedals, seats, and a video monitor. HRT users can choose the type of motorcycle to be used in the simulation, such as automatic transmission, duck (cub), or motorsport, and can also choose riding times, such as day, night, or foggy. The simulation program for this HRT consists of six (6) types of scenarios; each scenario has a different road map and traffic situation but has relatively the same challenge weight. In each scenario, respondents will encounter many cases on the road, such as pedestrians suddenly crossing, taxis suddenly pulling over and stopping, trucks opening their doors carelessly, vehicles suddenly turning around, and many others. At the end of the HRT session, two (2) evaluation outputs will be issued in the form of: 1. the riders' behavior score in each simulation scenario; and 2. the result of whether the driver had an accident or not.

![Figure 1. Honda Riding Trainer (HRT): (a) The simulator tools; and (b) Its interface](image-url)
Each respondent was given 10 minutes to practice on the exercise program before being tested on the road program with a predetermined time choice; it was done as a form of control over the research. In each simulator scenario, riding performance, errors, accidents, and road code violations are logged automatically. Riding performance is assessed on a four-level scale [26], which is adjusted for the results of the HRT simulator tool, namely: A = 3, which means safe behavior (no accidents, hazards avoided without braking hard or approaching other vehicles, following the speed limit), B = 2, which means precautionary behavior (not following the speed limit, braking hard, approaching other vehicles), C = 1, which means dangerous behavior (violating violently near other vehicles), and D = 0, which means having an accident. Another output obtained from this HRT is whether or not the driver had an accident.

The analysis carried out in this study is divided into two parts: the first is SEM analysis using WarpPLS 5.0 software to model the dynamics of the relationship between the rider's character (BF) and riding performance by adding mindfulness as a mediating variable and 3 (three) moderating variables, namely the age of the driver (Ma), the age when he started riding (Ms), and accident history (Mh). Then, logistic regression analysis was carried out with IBM SPSS Statistics 23.0 to form a motorcycle accident probability model. The 95% significance level is a criterion for estimating model parameters. This study produced 2 (two) models, where the purpose of each model analysis, analysis method, and variables are presented in Table 2, and the theoretical framework as seen in Figure 2.

### Table 2. Models aim, methods, and variables

<table>
<thead>
<tr>
<th>Aims</th>
<th>Analysis method</th>
<th>Variable Types</th>
<th>Variable Names (Symbol)</th>
<th>Measuring Scale</th>
<th>Coding/Weight</th>
</tr>
</thead>
<tbody>
<tr>
<td>To model the relationship between riders' personalities and riding performance</td>
<td>Structural Equation Modeling (SEM) with WarpPLS 5.0</td>
<td>Exogenous</td>
<td>Conscientiousness (Xc)</td>
<td>Ordinal</td>
<td>Xc1 - Xc6</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Exogenous</td>
<td>Extraversion (Xe)</td>
<td>Ordinal</td>
<td>Xe1 - Xe5</td>
</tr>
</tbody>
</table>
| | | Endogenous | Riding performance (P) | Ordinal | A = 3  
B = 2  
C = 1  
D = 0 |
| To model the probability of a motorcyclist crash | Logistic Regression with IBM SPSS Statistics 23.0 | Exogenous | Gender (G) | Nominal | Female (0)  
Male (1) |
| | | Exogenous | Riding performance (P) | Ordinal | A = 3  
B = 2  
C = 1  
D = 0 |
| | | Endogenous | Probability of having an accident (Y) | Nominal | Accident (0)  
No accident (1) |

**Figure 2. Theoretical Framework**
3. Results and Discussion

3.1. Descriptive Analysis

The majority of the respondents (79%) were male (Figure 3), and Figure 4 shows that the automatic transmission motorcycle is the most widely used by the respondents (57%).

![Figure 3. Gender](image1)

![Figure 4. Motorcycle transmission type](image2)

The age of the riders ranges from 18 to 56 years old, and the average age is 24 years old (mean (M)=23.677, standard deviation (SD)=2.963). Meanwhile, 91% of the respondents were 18-29 years old (Figure 5). Moreover, most respondents (71%) have ridden a motorcycle before 17 years old. The age when they started riding a motorcycle was from 7 to 38 years old (M=15.311, SD=1.991) (Figure 6); in fact, the minimum age for gaining a driving license in Indonesia is 17 years old.

![Figure 5. Age](image3)
The accident history data based on the questionnaire show that 41% of respondents (M=1.457, SD=1.008) have never been involved in an accident (Figure 7). Meanwhile, the rider personality data based on the Big Five inventory shows that most riders have the dominant personality of agreeableness (46%) and the most minor personality of neuroticism (Figure 8).

Riding simulation results using the Honda Riding Trainer (HRT) are presented based on the riders' performance category (Figure 9) and their experience of an accident (Figure 10). The survey has revealed that the majority (46%) of
the riders’ performance is in category B, indicating precautionary behavior (not following the speed limit, braking hard, and approaching other vehicles). Meanwhile, 41% of the riders have an accident on the HRT simulator.

![Figure 9. Rider’s performance](image)

![Figure 10. Simulation result](image)

3.2. SEM Analysis

3.2.1. Confirmatory Factor Analysis

Adaptation of the BFI and MAAS personality measurement tools into Indonesian so that they are more appropriate to the language style and cultural context of Indonesia is carried out by setting the Chi-square ($\chi^2$) criteria, which are expected to be small, $p \geq 0.05$, The Root Mean Square Error of Approximation (RMSEA) $\leq 0.05$, Comparative Fit Index (CFI) $\geq 0.90$ and The Root Mean Square Residual (RMR) $\leq 0.05$. Reliability testing is carried out by looking at the Composite Reliability (CR) value; namely, if the CR value is $> 0.7$ or Cronbach’s Alpha value $> 0.6$, then the variable is declared reliable [33, 34, 37].

3.2.2. The Goodness of Fit Model

The goodness of fit model in WarpPLS is carried out using the coefficient of determination (R-Square) and the Q-Square predictive relevance (Q-Square). The R-squared values of the goodness of fit model analysis showed that the BF variable ($X_o, X_c, X_e, X_a, X_n$) contributes to the mindfulness variable by 36.2% and that the riding performance variable can be explained by BF, the mindfulness variable, and the moderating variable by 28%. The remaining 63.8% and 72% values are contributions from other factors not discussed in this study. Then, the Q-squared of mindfulness variables and the riding performance are positive, indicating that exogenous variables can predict endogenous variables.

3.2.3. Direct Effect Hypothesis Testing

The path diagram for the results of the testing is shown in Figure 11. Converting the path diagram to a structural model in the following mathematical equation model (Equation 1):
From Equation 1, it can be seen that of the five Big Five Personality dimensions, only the Openness, Conscientiousness, and Neuroticism variables are significantly correlate with mindfulness. As shown in Table 1, someone with the dominant trait of Openness tends to have curiosity, broad interests, creativity, originality, imagination, and non-traditionalness. The positive correlation of openness with mindfulness shows that someone who is dominant in the trait of openness will find it easier to be mindful on the road, meaning that he or she will be more attentive and alert to traffic situations. Positive values also apply to the conscientiousness trait, which can be interpreted as the riders who are dominant in conscientiousness acting in line with mindfulness, for example, responding effectively rather than reacting impulsively or habitually [13]. Neuroticism is a BF trait that resists attention negatively. Neurotic individuals tend to have an anxious driving style and consider other drivers as an additional source of stress [38], in contrast to mindful individuals with a more remarkable ability to tolerate various thoughts, emotions, and experiences [39]. This result strengthens a previous meta-analysis of the relationship between mindfulness and the Big Five personality traits, the results of which showed similar positive and negative values in the correlation [40]. The correspondence between each dimension trait and how the relationship occurs between BF and mindfulness in this study provides additional knowledge for researchers who are trying to reconsider how mindfulness is conceptualized in relation to established, well-understood constructs such as the Big Five personality traits and its positive and negative affect [41]. This will be an important insight to explore for researchers to continue to learn more about mindfulness.

The coefficient for the relationship between the mindfulness variable and riding performance, as seen in the path diagram (Figure 11), is 0.119, so:

\[ P = 0.071\ Xo - 0.059\ Xc - 0.029\ Xe + 0.095\ Xa - 0.092\ Xn + 0.119\ M \] (2)

From Equation 2 and the p-value in Figure 11, it can be seen that the variables significantly correlated with riding performance are two (2) dimensions of BF (Agreeableness and Neuroticism) and Mindfulness. In contrast to agreeableness and mindfulness, which have positive values, neuroticism has a negative correlation with riding performance, which means that the dominant trait of neuroticism of the riders will reduce their riding performance. These results contributed to the differences compared to previous studies [42], which showed that together, these five factors accounted for 38% of Risky Driving Behavior (RDB). In contrast, in another study [43], it was found that there
were only 3 (three) significant factors (neuroticism, agreeableness, and conscientiousness). Another study showed that there is a positive effect of neuroticism and a negative effect of agreeableness and conscientiousness on RDB [44], while trait extraversion has no significant effect on RDB [14].

Direct effect hypothesis testing is also carried out to see the role of moderator variables in strengthening or weakening the relationship between variables. For the moderating variable, there are three significant correlations in the moderating relationship between personality variables (Big Five) and riding performance (Table 3), while the only significant moderating variable on riding performance is the age when start riding (Figure 11).

Table 3. Moderating results of the Big Five variables on riding performance

<table>
<thead>
<tr>
<th>Exogenous</th>
<th>Moderator</th>
<th>Path Coefficient</th>
<th>SE</th>
<th>p-Value</th>
<th>Moderation Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>Openness</td>
<td>Age</td>
<td>-0.115</td>
<td>0.049</td>
<td>0.011*</td>
<td>Absolute</td>
</tr>
<tr>
<td>Agreeableness</td>
<td>Accident history</td>
<td>0.086</td>
<td>0.05</td>
<td>0.043*</td>
<td>Pure</td>
</tr>
<tr>
<td>Extraversion</td>
<td>Accident history</td>
<td>0.122</td>
<td>0.049</td>
<td>0.007*</td>
<td>Absolute</td>
</tr>
</tbody>
</table>

Note: * p < 0.05

Based on Table 3, it can be explained that the age variable is an absolute moderating variable, which means that the existence of this variable is needed so that the openness variable is significantly correlated with riding performance. The same type of moderation also applies to the accident history variable, which moderates the extraversion variable on riding performance. Accident history can also play a pure role only as a moderating variable (pure moderation), which moderates the agreeableness variable to correlate with riding performance significantly. For the variable of age when starting to ride, the analysis results show that this variable, originally hypothesized as a moderating variable, turns out to be significantly correlated as an exogenous variable with riding performance. The significance of the age variable as a moderating variable is in line with the research of Haerani et al. [45] and Mahachandra et al. [46], which found that the higher the age, the stronger the influence of personality on driving behavior. The same personality may influence driving behavior and driving outcomes at different age levels for different drivers. At a young age, drivers with a patient, calm, friendly, tolerant character and the ability to avoid conflict can behave recklessly on the road and commit traffic violations that can cause accidents.

Since age plays a significant role in influencing the strength of the relationship between personality and riding behavior, it is necessary to implement safety policies based on the driver's age. Descriptive data in Figure 6, which shows that almost 30% of motorists start riding motorbikes under the minimum age to obtain a driving license, shows that there should be an extra concern for teenage riders. This concern could be in the form of introducing traffic rules from an early age, which can be done by including traffic safety material in the school curriculum from elementary school.

3.2.4. Indirect Effect Hypothesis Testing and Dominant Effect

The indirect coefficient results from multiplying the direct coefficient of BF traits-Mindfulness with the direct coefficient of Mindfulness-Riding Performance. The results of testing the indirect influence hypothesis (Table 4) show that the mindfulness variable is not significant in mediating the relationship between the Big Five personality and the riding performance of motorcyclists.

Table 4. The results of direct and indirect effect hypothesis testing and dominant effect

<table>
<thead>
<tr>
<th>Exogenous</th>
<th>Mediator</th>
<th>Endogenous</th>
<th>Coefficient</th>
<th>SE</th>
<th>p-Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Openness</td>
<td>Mindfulness</td>
<td>Riding Performance</td>
<td>-0.071</td>
<td>-0.014</td>
<td>0.057</td>
</tr>
<tr>
<td>Conscientiousness</td>
<td>Mindfulness</td>
<td>Riding Performance</td>
<td>-0.025</td>
<td>-0.013</td>
<td>-0.091</td>
</tr>
<tr>
<td>Extraversion</td>
<td>Mindfulness</td>
<td>Riding Performance</td>
<td>-0.095</td>
<td>-0.008</td>
<td>0.087</td>
</tr>
<tr>
<td>Agreeableness</td>
<td>Mindfulness</td>
<td>Riding Performance</td>
<td>-0.092</td>
<td>0.047</td>
<td>-0.045</td>
</tr>
<tr>
<td>Neuroticism</td>
<td>Mindfulness</td>
<td>Riding Performance</td>
<td>0.119</td>
<td>0.119</td>
<td>0.049</td>
</tr>
</tbody>
</table>

Note: * p < 0.05
This study has not succeeded in showing the role of mindfulness as a mediator of BF on riding performance; however, from Figure 11, it could be seen that mindfulness is a significant exogenous variable that is positively correlated with riding performance, which supports the earlier research [20, 40]. This finding is interesting because, as previously discussed, there is a correspondence between the personality constructs of BF personality and mindfulness. In contrast to the definition of the BF trait, which is conventionally assumed to be a relatively stable personality trait, research related to mindfulness shows that the mindfulness personality can change over time as a result of life experiences or through mindfulness practice [23, 47, 48]. It is also quite interesting to see the results of previous research [49] where the mindfulness variable is placed as an exogenous variable while BF is the mediator, showing the results that conscientiousness and neuroticism significantly mediated the effects of the relationship between the subject’s mindfulness levels and the riding performance. These variations of mindfulness position as a variable supply a space to conduct more research regarding how mindfulness training could be used as a therapy for motorcyclists in intervening with personality interventions.

The total coefficient value is also presented in Table 4, which results from the sum of the direct and indirect coefficients. From Figure 11, the neuroticism variable has the most significant coefficient value (0.394) compared to the mindfulness variable. Thus, neuroticism has the most dominant influence on mindfulness. Furthermore, the variable with the most significant total coefficient on riding performance is conscientiousness, with a total coefficient of 0.091. Neuroticism is a negative character characterized by individuals who are easily nervous, often feel worried, easily tensed, and easily depressed. At the same time, conscientiousness is a positive character characterized by being reliable, responsible, diligent, and achievement-oriented individuals [33]. This result differs from previous research conducted in Indonesia [45], indicating that agreeableness is the BF variable with the most dominant influence on driving performance. Overall, SEM analysis reveals that the Big Five are quite powerful in directly predicting the mindfulness and riding performance of motorcyclists.

3.3. Logistic Regression Analysis

In this analysis, the 'no accident' category (coding 0) becomes the reference category, with 162 respondents (41%) who have never had an accident. The contribution of riding performance, gender, and motorcycle type variables to accident probability is obtained from the coefficient of determination of the Nagelkerke R-Square, which is .507 or 50.7%. This means that these variables contribute 50.7%, while the rest are influenced by other variables not discussed in this study. The simultaneous test gives the chi-square value for the whole model 186.822 with a p-value < 0.001* significance level. This means that the model simultaneously significantly influences the chance of an accident. At the same time, for the partial significance test, the value shows that the variable Motorcycle Transmission Type (T) is not significant (Table 5). Therefore, it is excluded from the estimation model (Equation 3).

### Table 5. Results of partial significance test

<table>
<thead>
<tr>
<th>Variable</th>
<th>Likelihood ratio test</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>B</td>
</tr>
<tr>
<td>Intercept</td>
<td>5.693</td>
</tr>
<tr>
<td>Riding Performance (P)</td>
<td>-2.447</td>
</tr>
<tr>
<td>Gender (G)</td>
<td>-0.726</td>
</tr>
<tr>
<td>Motorcycle Transmission Type (T)</td>
<td>-0.214</td>
</tr>
</tbody>
</table>

The probability model for a motorcyclist accident is:

\[
\log\left(\frac{Prob(Y1)}{Prob(Y0)}\right) = 5.693 - 2.447 P - 0.726 G
\]

(3)

Based on the calculation of the logistic regression using Equation 3, as shown in Table 6, it is found that for the same level of performance, female riders contribute more than double the probability of having an accident than male drivers. Although this result is in line with previous research [50], however different from most of the previously published studies [51–54], which state that male drivers are the most at-risk and most involved in accidents. The difference in this finding may be related to the unequal gender distribution in the sample. Since 79% of the sample were male participants (Figure 3), a female’s road crash during the test would have stronger gender effects. The unequal gender distribution of the sample may exert a significant bias in this finding. Another finding from logistic regression analysis was that the worse the rider’s performance, the higher the chance of having an accident. This result is in line with previous studies, namely that the chance of a person having an accident is strongly influenced by driving performance [45].
This study and many previous studies on personality factors analyzed based on the Big Five personality in relation to traffic safety tend to give varying results. This can happen, which may not only be due to different analytical tools and methods but also shows how human personality is a very complex subject. Some of the limitations of this research are due to the restrictions on the COVID-19 pandemic, so the respondents involved are not varied enough. Respondents who are primarily young drivers who see the HRT simulation tool as a game tool also make them less serious during the simulation. However, the experiment with the HRT simulator is not the same as the actual driving test. Thus, it may not be appropriate to investigate driving behavior that may differ from typical driving behavior on the road. Still, driving simulator experiments are necessary to control for multiple scenarios and many experimental variables. The use of HRT in this study is an approach method that seeks to provide insight into the results of using HRT in analyses of motorcycle rider performance in relation to traffic accidents. Considerations for using HRT in future studies include applying more realistic situation settings, perhaps ambient sounds and outdoor conditions, as well as selecting respondents who are serious about carrying out the simulation and a longer adaptation time with the tool.

Another reason for the varying results might be the location of this study, Indonesia, which is a middle-income country [55], where personality measurements based on the Big Five inventory show contrasting differences in validity levels between respondents with low and high education, as well as distortion of measurement results related to the interaction of respondents with surveyors [56]. The results of this study were obtained without filtering out possible outliers due to unreliable respondents. For this reason, it is recommended that further research be carried out by filtering the data, one of which is by eliminating the highest and lowest values of 5% of the total value of the questionnaire. Overall, SEM analysis reveals that the Big Five are quite powerful in directly predicting the mindfulness and riding performance of motorcyclists.

4. Conclusion

This study contributes results that are able to describe the dynamics of the relationship between psychological traits, riding performance, and the probability of being involved in an accident. SEM analysis shows that only the neuroticism variable predicts mindfulness and riding performance significantly. The openness and conscientiousness variables only significantly predicted mindfulness, while agreeableness was the only BF personality that significantly predicted riding performance. The mindfulness variable, which in this study is expected to play a significant role as a mediator of the BF variable on riding performance, has not been able to become a mediating variable but is significantly strong enough as an exogenous variable for riding performance. This finding shows that although mindfulness has become a popular concept in the last decade, due to the broad scope of human personality, further research is needed on the effect of mindfulness related to its role both as a trait and, especially, as a state quicker to intervene in the form of interventions so that it can improve riding performance.

The logistic regression analysis found that the worse the rider’s performance, the higher the chance of having an accident, and female riders contribute more than double the possibility of having an accident than male riders. These results indicate the need to conduct research on road safety that is differentiated by sex and their characteristics based on it. This research, with a combination of endogenous, exogenous, mediator, and moderator variables, as well as a combination of analytical methods and the use of simulators, is one of the first in Indonesia and certainly requires further validation.

5. Declarations

5.1. Author Contributions

Conceptualization, B.M.E., D.L., and Y.C.A.; methodology, D.L. and Y.C.A.; software, B.M.E. and W.A.; formal analysis, B.M.E.; writing—original draft preparation, B.M.E.; writing—review and editing, D.L. and Y.C.A.; visualization, W.A.; supervision, D.L. and W.A. All authors have read and agreed to the published version of the manuscript.

5.2. Data Availability Statement

The data presented in this study are available in the article.
5.3. Funding
The authors received no financial support for the research, authorship, and/or publication of this article.

5.4. Conflicts of Interest
The authors declare no conflict of interest.

6. References


