A COMPARATIVE STUDY ON PERCEIVED ACCIDENT RISK AMONG THE CYCLISTS, MOTORCYCLISTS AND DRIVERS IN THE MIXED TRAFFIC.

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SCHOOL OF CIVIL ENGINEERING
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ABSTRAK

Motosikal adalah satu bentuk pengangkutan biasa di Malaysia, manakala basikal baru-baru ini mendapat kebangkitan semula dalam popularititi, terutamanya sebagai satu bentuk rekreasi dan senaman. Kemalangan jalan raya kerap berlaku di Malaysia dan semakin teruk setiap tahun. Kajian ini menyiasat persepsi risiko dalam kalangan penunggang basikal, penunggang motosikal, dan pemandu untuk membangunkan dan melaksanakan strategi mitigasi untuk meningkatkan keselamatan jalan raya dalam lalu lintas bercampur di Malaysia, dengan tujuan mengurangkan kadar kemalangan. Kajian ini memberi tumpuan kepada pemandu dan penunggang motosikal yang bekerja serta penunggang basikal rekreasi di Pulau Pinang. Melalui soal selidik, data demografi dan persepsi risiko yang dilaporkan sendiri telah dikumpulkan. Analisis statistik dilakukan menggunakan Statistical Product and Service Solution (SPSS). Penyelidikan ini menilai perbezaan ketara dalam persepsi risiko antara penunggang basikal, penunggang motosikal dan pemandu. Walaupun terdapat perbezaan yang signifikan dalam sosio demografi, pengalaman, dan ciri-ciri perjalanan untuk pemandu, penunggang motosikal, dan penunggang basikal, hanya 3 daripada 16 risiko persepsi yang dilaporkan sendiri adalah perbezaan yang ketara, iaitu: responden tidak mempunyai masalah untuk menyesuaikan pemanduan, motisikal atau basikal diri mereka dengan keadaan permukaan jalan; responden boleh mengelamun apabila mereka memandu, menunggang atau berbasikal; dan kehadiran seseorang bersama responden di dalam kereta, di belakang mereka di atas motosikal atau penunggang basikal lain di belakang mereka mengganggu dan menjejaskan pemanduan. Terdapat hanya 1 daripada 3 risiko yang dilaporkan sendiri terhadap pengguna jalan raya lain yang mempunyai perbezaan yang ketara, iaitu di kalangan pemandu dan penunggang motosikal, mereka akan mengurangkan kelajuan mereka apabila mereka melihat motosikal di jalan raya.

ABSTRACT

In Malaysia, motorcycles are a common mode of transportation, while cycling has recently had a resurgence in popularity, primarily as a form of recreation and sport. Road accidents happen often in Malaysia and are getting worse every year. This study investigates risk perceptions among cyclists, motorcyclists, and drivers in order to develop and implement mitigation strategies to improve road safety for cyclists, motorcyclists, and drivers in mixed traffic in Malaysia, with the aim of reducing the accident rate. The focus of this study was on working drivers and motorcyclists as well as recreational cyclists in Penang. Through a questionnaire, demographic data and self-reported risk perception were collected. Statistical Product and Service Solution (SPSS) was utilized to perform the statistical analysis. This research evaluated the significant difference in risk perception between cyclists, motorcyclists, and drivers. Although there is a significant difference in the socio demographic, experience, and characteristics of travel for drivers, motorcyclists, and cyclists, only 3 variables out of 16 self-reported perceived risks are significant differences, which are: the respondents have no problem adapting their driving, riding, or cycling to road surface conditions; the respondents can be lost in their thoughts when driving, riding, or cycling; and the presence of someone with the respondents in the car or on the motorcycle or behind them distracts them and deteriorates their driving, riding, or cycling. There is only 1 variable out of 3 self-reported perceived risks towards other road users that has a significant difference, which is among the drivers and the cyclists that they will reduce their speed when they see motorcycles on the road.

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ANOVA	Analysis of Variance
SPSS	Statistical Package for Social Sciences

CHAPTER 1

INTRODUCTION

1.1 Background of Study

According to World Health Organization (2018), the number of traffic-related deaths continued to grow in 2016, reaching a record high of 1.35 million. Meanwhile, car occupants account for 29% of all fatalities. Globally, pedestrians and cyclists account for 26% of all fatalities, while those riding motorized two- and three-wheelers account for another 28%. On the other hand, each year, over 41, 000 bikers are killed and account for 3% of global road traffic fatalities (World Health Organization, 2020). Besides, in the United States in 2019, 5,115 people died and 79,000 were injured in motorcycle accidents (The Ultimate Resource for Motorcycle Accident Statistics 2021, 2021). In 2019, 16,884 cyclists were injured in traffic incidents in the United Kingdom, including 4,433 fatalities or severe injuries (Accident rates, 2022).

In Malaysia, buses were involved in accidents at a rate of 17% between 2004 and 2013, ahead of taxis (11%), trucks (7%), and passenger vehicles (6%) (Khairul Amri Kamarudin, et al., 2018). In additional, according to 2018 police statistics, cyclist fatalities in Malaysia are quite low, accounting for less than 2% of total road crash fatalities, or 6284 deaths (Ministry of Transport Malaysia, n.d.). In Malaysia, the number of traffic accidents has climbed during the last ten years and registered 567516 accidents in 2019 (Ministry of Transport Malaysia, n.d.). Motorcyclists accounted for 70.2% of the 2,954 nationwide fatalities (all types of vehicles) from January to August 2021, according to official figures from Bukit Aman's traffic department (Tamrin, 2021).

However, cycling has recently had a resurgence in popularity on Malaysian roads, especially for sport and recreation. In response to the growing popularity, the government and local public authorities have joined forces to promote this environmentally friendly

mode of transport by constructing bicycle tracks and lanes to make cycling safer (Ministry of Transport Malaysia, n.d.). Apart from the health benefits, cycling is a cheap mode of travel that provides flexible mobility, enables cyclists to avoid traffic congestion, and supports to multimodal transportation connections (Acheampong, 2017). Bicycles are permitted on trains and buses in several cities, allowing cyclists to ride at both ends of their trip (Jalalkamali & Ghraei, 2012). The bicycle can cover sufficient distances to accomplish many urban and suburban journeys more effectively than walking and, in certain situations, faster than other modes of transport. Cycling trips are also more environmentally friendly than motorised trips because they emit no pollutants directly, such as greenhouse gases or noise (Acheampong, 2017).

1.2 Problem Statement

Motorcycle is a major mode of transport in Malaysia. However, most of the streets in Malaysia is planned, thus the motorcycles need to share the same area with the cars. It results in conflict between motorcycles-cars travelling in the same direction. The motorcycles are typically travel slower than cars in mid-stream (Hsu, Dao, & Sadullah, 2003).

Cycling has recently had a resurgence in popularity on Malaysian roads, especially for sport and recreation (Ministry of Transport Malaysia, n.d.). The increasing number of cyclists increases the chance of being involved in an accident. When it comes to driving on roads, each group of road users has a different perception of the risks.

Risk perception is a personal evaluation of risk level and characteristics that are closely related to accident. However, there is also a positive correlation between perceived risk and self-reported reckless driving (Harbeck, Glendon, & Hine, 2017). Traffic risk perception is often subjective, based on personal experiences with accidents

(Eboli, Mazzulla, & Pungillo, 2017). Perceived risk decreases as skill level increases; drivers who perceive themselves to be more skilled may perceive they are less likely to engage in risky road behaviors, better able to control the risky consequences of violating traffic regulations, and better able to anticipate and respond to an external risk source. (Chaurand & Delhomme, 2013). Since there are lack of understanding on risk preception study in Malaysia, this thesis is aim to better understanding on risk preception among the drivers, motorcyclists and cyclists focusing on road users in Penang. This study investigates risk perceptions among cyclists, motorcyclists, and drivers in order to plan and implement mitigation measures to improve road safety for cyclists, motorcyclists, and drivers in mixed traffic, with the goal of lowering the accident rate in Malaysia.

1.3 Objectives

The aims of this study are as follows:

1) To identify the level of perceived risk among cyclists, motorcyclists and drivers in Penang.
2) To analysis the significant different of perceived risk among cyclists, motorcyclists and drivers in Penang.

1.4 Scope of Work

The respondents of this study are people who commute to work via motorcycle or car, as well as recreational cyclists in Penang. The data collected in this study were related to self-reported risk perception, with a specific focus on self, and other vehicles. The respondents must be Malaysian, aged above 18 years old and currently residing in Penang. If a respondent can be a driver, motorcyclist, and cyclist simultaneously, the questionnaires must be differentiated.

This study considers the domain mode of transport for drivers and motorcyclists. But for cyclists, most of the respondents are the recreational cyclists who maybe drive or ride motorcycle to work. Therefore, the respondents are reminded to perceived accordingly based on the need of the questions. The respondents only allowed to answer one questionnaire form only if any of them are a driver, a motorcyclist and a cyclist at the same time.

CHAPTER 2

LITERATURE REVIEW

2.1 Perceived Risk and Road Accident

Perceived risk is the expectation of being in an accident (Eboli, Mazzulla, & Pungillo, 2017). According to Lund & Rundmo (2009), attitudes and perceived risk were significant indicators of hazardous behaviour and accidents. Perception of risk is a subjective evaluation of risk severity and attributes. However, there is also a positive correlation between perceived risk and self-reported reckless driving (Harbeck, Glendon, & Hine, 2017).

Traffic risk perception is often subjective, based on personal experiences with accidents (Eboli, Mazzulla, & Pungillo, 2017). It was found that perceived risk was a good predictor of how likely a young driver was to get into an accident. However, reported risky behaviour weakened this link. For example, it helps predict reckless driving, reduce collision risk, develop safety campaigns, and encourage young drivers to drive safely (Harbeck, Glendon, & Hine, 2017).

The process of measuring risk perceptions using numerical rating scales, often known as "the psychometric paradigm," was developed to describe and evaluate perceptions in a number of ways. Comparing and contrasting risk perceptions and attitudes between groups was suitable to psychometric techniques (Paul, 2016).

The public has a qualitative and comprehensive definition of risk that includes uncertainty, dread, catastrophic potential, controllability, equity, risk to future generations, and so on (Paul, 2016). The distinction between cognitive and emotional subjective risk evaluation is critical. There is both a rational and affective element to risk perception. The affective element consists of anxiety and emotional responses, while the rational element consists of probability judgments and perceptions of traffic risk.

Perceiving risk in various circumstances is an individual phenomenon. The degree to which an individual perceives risk varies and depends on past experiences, social and personal circumstances (Ram & Chand, 2016). Risk perception is important because it affects behaviour. Aspects of risk perception that are rational were not significant predictors of self-reported risk behaviour in the model tests as worry and emotional reactions predicted behaviour (Rundmo & Iversen, 2004).

According to Nordfjærn & Torbjørn (2009), individuals with varying demographics have no effect on traffic danger perception. The younger males do not perceive their increased risk of being engaged in fatal traffic accidents than older males and females (Åstrøm, Moshiro, Hemed, Heuch, & Kvåle, 2006). Younger males may be more likely to be involved in traffic accidents in both developing and developed countries (Nordfjærn & Torbjørn, 2009). The risk of being injured or killed in a traffic accident is especially high for those with a low socioeconomic status; however, there are also important risk factors for road traffic collisions that are intrinsic social determinants of health, such as behaviour, lifestyle, education, and employment (Klaitman, Solomonov, Yaloz, & Biswas, 2018).

In comparison to adults and older adults, adolescents were less risk averse, evaluated the severity of consequences to be less severe, and were more eager to accept risks. These imply that teenagers have a tendency to perceive risks as less and to take greater risks than other age groups (Lund & Rundmo, 2009). Young drivers are typically linked with unsafe driving behaviours that can result in accident involvement (Tarlochan, Ibrahim, & Gaben, 2022). Moreover, the majority of road traffic accidents, deaths, and injuries occur in low- and middle-income nations (Scott-Parker & Oviedo-Trespalacios, 2017). According to Hatfield & Fernandes, 2009, in comparison to older drivers, younger drivers demonstrated a lower risk aversion and a greater proclivity for risky driving, as

well as stronger intentions for risky driving. However, their study found that older and younger drivers had distinct patterns of connection between perceived danger and hazardous behaviour, but the observed pattern of outcomes was typically similar for older and younger drivers, as well as male and female drivers (Hatfield & Fernandes, 2009). Besides, according to Ulleberg & Rundmo (2003), risk perception had a non-significant relationship with risk behaviour, indicating that it is a weak indicator of adolescent risk behaviour (Ulleberg & Rundmo, 2003).

The perceived risk of road injury differed across urban and rural settings (Åstrøm, Moshiro, Hemed, Heuch, & Kvåle, 2006). Urban adults were twice as likely as rural adults to be injured in traffic, but rated their vulnerability nearly four times higher (Åstrøm, Moshiro, Hemed, Heuch, & Kvåle, 2006). Urban residents assessed greater risk of road traffic injuries than rural residents. This regional difference may be due to lack of safety awareness and personal danger experience in rural populations (Åstrøm, Moshiro, Hemed, Heuch, & Kvåle, 2006).

Besides, according to Cho, Rodríguez, & Khattak (2009), the neighbourhood compactness and land use appeared to be directly associated to perceived and actual pedestrian and bicycle-involved vehicular collisions, their effects were partially mitigated by indirect pathways. In general, increased community compactness and mixed land uses were positively correlated with actual risk, but neighbourhood compactness was positively associated with perceived risk and mixed land uses was negatively associated with perceived risk (Cho, Rodríguez, & Khattak, 2009). Differences in traffic surroundings and accident rates may contribute to perceived traffic risk. There is a positive correlation between traffic risk perception and traffic environment (Nordfjærn & Torbjørn, 2009). The traffic environment of the country in which a driver mostly drives a motorized vehicle may influence his or her behaviour in traffic context as the

differences in driver conduct may be the perception of the traffic climate in their respective countries (Üzümcüoğlu, Özkan, Wu, & Zhang, 2019).

According to Lund & Rundmo (2009), males perceived risks to be lower than females. However, according to Åstrøm et al. (2006), males evaluated their road traffic vulnerability as equivalent to women, injury morbidity rates showed that men were more likely than women to suffer such injuries. This may be explained by men and women underestimating and overestimating their personal risk, respectively. Men are more optimistic about preventing injuries and regard injuries as a result of misfortune than women (Åstrøm, Moshiro, Hemed, Heuch, & Kvåle, 2006).

Besides, according to Griffin, Haworth, & Twisk (2020), female drivers and female cyclists assessed hazards similarly and consistently higher than male drivers and cyclists. Women perceived themselves to be less proficient, as they felt less in control, were more frequently inattentive, and lacked confidence. They supported for tougher traffic laws and enforcement, felt less safe in general, and did not downplay the consequences of violations as much as men did. This pattern was consistent for female cyclists and drivers alike. Women who cycle regularly reported having the same elevated risk perceptions as women who drive but do not ride often (Griffin, Haworth, & Twisk, 2020). Individuals who had been in three or more serious accidents evaluated road travel as less risky and behaved less safely. Those who had three or fewer accidents perceived driving as unsafe and acted accordingly. Drivers who had been involved in crashes feared traffic risks more than others and as they fear road accidents more, leading to safer driving (Ngueutsa & Kouabenan, 2016).

In general, drivers and cyclists differed more in their attitudes than in their skills and ability, with the most major difference being that cyclists felt significantly less safe in traffic than car drivers. Inattention and downplaying the repercussions of own-

violations were highly associated with perceived risk in both bikers and drivers. Inattention (being absent-minded, rushing, or failing to observe other road users) was connected with increased perceptions of risk while neglecting consequences was related with a decreased perception of risk (Griffin, Haworth, & Twisk, 2020).

Perceived driver recklessness and driver drunkenness are the major causes of traffic injuries (Åstrøm, Moshiro, Hemed, Heuch, & Kvåle, 2006). Furthermore, greater reported confidence in safe driving (self-efficacy) was associated with decreased perceived risk. This could be because individuals who expressed greater confidence in safe driving also perceived less risk, as the risky driving behaviours assessed did not apply to them (Harbeck, Glendon, & Hine, 2018).

Road conditions and lack of police enforcement were attributed for road traffic injuries (Åstrøm, Moshiro, Hemed, Heuch, & Kvåle, 2006). The insufficient separation between pedestrians, cyclists, and motor vehicles also increases the perceived risk of being a pedestrian or cyclist (Nordfjærn & Torbjørn, 2009). Drivers and cyclists perceived greater risk of car violations than bicycle violations. However, the difference between drivers and cyclists was found to be smaller which indicates drivers are aware of the potential risk of injury to cyclists (Griffin, Haworth, & Twisk, 2020). However, perceived risk was higher for car drivers than for cyclists, and for interaction with a car was greater than for interaction with a bike (Chaurand & Delhomme, 2013).

2.2 Drivers' Perceived Risk

Risky driving leads to road traffic injuries, the greatest cause of death among adolescents. There is a negative correlation between reckless driving and perceived risk of its consequences (Hatfield, Fernandes, & Job, 2014). A typical argument for why teenagers take risks, especially those involving driving, is that they lack an effective risk

assessment ability, overestimate their control over their driving abilities and results, and consider themselves as invulnerable to injury. Despite the emphasis on low risk perceptions as a possible explanation for teen risky driving, it is equally possible that adolescents engage in risky driving or fail to emphasise safe driving in part because they are more focused on the benefits of driving, such as independence and appearing "cool" in front of their peers. Those who face a high crash risk but perceive it to be low have lowered risk perception, whereas those who deliberately avoid danger have the opposite tendency (Keating & Halpern-Felsher, 2008).

In the case of perceived risk, the predictive value of a demographic factor (gender) and a situational factor (road type) was almost negligible. Two constructs, threat and costly damage, were elicited from subjects to make the most significant contribution (Calisir & Lehto, 2002). Additionally, perceived personal risk was found to moderate the association between gender and driving while fatigued only, while gender was found to moderate the relationship between perceived risk and risky driving, including drunk driving and driving without a seat belt (Fernandes, Hatfield, & Job, 2010).

Male drivers were more likely to engage in dangerous driving behaviours than female drivers, and teen drivers were more likely to engage in risky driving behaviours than adult drivers (Rhodes & Pivik, 2011). Young drivers had higher reported involvement in traffic violations and lower perceived risk (Harbeck & Glendon, 2018). Affect and risk perception were significant determinants of risky driving behaviour independently. Positive affect and perceived danger interacted more strongly with gender and age to predict risky driving in teen and male drivers than in adult and female drivers. Male and teen drivers were consistently more likely to report both liking and considering these risky actions as less risky than female and older drivers (Rhodes & Pivik, 2011).

Young adults often drive carelessly and put other people and themselves in danger. Continuous lane changes are an example of such dangerous behaviour (Wang X, 2021). Driving under the influence of alcohol or drugs affects driving ability and, as a result, raises the risk of accidents. For young drivers, the danger of driving under the influence is five times greater (Schroeter, 2021). Young drivers are far more likely to be involved in motor vehicle accidents due to fatigue. Young drivers are susceptible to fatigue due to biological predispositions, societal influences, and lack of experience. Reduced attentiveness, poorer judgement, and a weak sense of danger are all signs of fatigue (Paterson & Dawson, 2016).

Trees in close proximity to roadways were perceived by drivers to increase risk, whereas night-time conditions with additional lighting were perceived to slightly reduce risk (Van Treese, Koeser, Fitzpatrick, Olexa, & Allen, 2018). In general, increased visual complexity, specifically situational distractions, was associated with increased risk perception via object density and pedestrian density. A possible explanation for these findings is that increased situational clutter makes it more difficult for drivers to efficiently manage attentional resources, resulting in information overload and an increase in perceived risk (Kooijman, 2021). Wide medians, wide paved roadways, and wide lateral clearance from obstructions lowered perceived risk, whereas frequent intersections and driveways, the presence of horizontal curves, and pedestrians and sidewalks raised perceived risk. Perceived risk of a crash and speed enforcement are considered speed deterrents, while the perceived value of a time gain is thought to be what makes people want to drive faster. According to this principle, drivers favour speeds that reduce perceived travel disutility (Tarko, 2009).

2.3 Motorcyclists' Perceived Risk

Impatient riders not only perceive more danger, but also seek utility from specific dangerous riding actions. Their lack of riding confidence and lack of awareness of traffic conditions, on the other hand, may indicate their immature riding abilities. These motorcyclists can be classified as nervous riders, as their dread of an accident causes them to ignore surrounding traffic conditions. While these riders appear to engage less risky riding behaviours, they may expose themselves to risky situations more frequently, especially if they are willing to engage in unsafe riding but lack the necessary abilities to support such actions (Wong, Chung, & Huang, 2010).

Motorcyclists demonstrated superior hazard perception compared to car drivers (Horswill & Helman, 2003). According to Horswill & Helman (2003), the motorcyclists travel faster, narrower gaps, and overtake more frequently than car drivers. The perceived risk of manoeuvres had a positive effect on the likelihood of being involved in an accident resulting in injury, indicating that riders who do not consider weaving between cars or overtaking in extreme conditions to be dangerous were more likely to report at least one previous accident. As a result, it is shown that risky attitudes are associated with an increased likelihood of being involved in a vehicle accident (Theofilatos & Yannis, 2014). In the sequence of events leading to a motorcyclist's road accident, motorcyclist errors, as well as failures in perception and decision-making, are among the most crucial behavioural characteristics (Topolšek & Dragan, 2016).

Age and driving experience influence riding behaviour via beliefs and attitudes that are associated with indices of human agency such as locus of control and perceived risk. These social psychological characteristics are most effectively viewed as moderators of impulsivity and risk-taking behaviour (Cheng & Lee, 2012). The positive link between the component related with drinking and riding and accident involvement is also

reinforced by the fact that younger adults are more likely to drink and drive, resulting in more accidents (Theofilatos & Yannis, 2014). Errors appear to be connected to experience. However, violations appear to be highest for motorcyclists with a modest level of experience. The number of violations appears to increase only once motorists obtain at least two years of experience. Prior to this, they may be more prone to be engaged in an accident as a result of human error. However, once they gain confidence in their abilities, the number of self-reported violations increases. (Crundall, Bibby, Clarke, Ward, & Bartle, 2008). In the road environment, risk perception appears to be strongly tied to self-confidence in one's driving ability. If people believe they are capable of dealing with dangerous situations well, they are less likely to regard a potential hazard as dangerous. Beginner riders who were also inexperienced drivers (all between the ages of 19 and 21) expressed slightly more confidence in their hazard recognition abilities than novice riders who were also expert drivers. Young motorcycle riders are also overconfident in their hazard assessment abilities, resulting in a mismatch between their perception of their own talents and their real abilities (Liu, Hosking, & Lenné, 2009). Female motorcycle riders were more likely to run red lights, text, and ride without a helmet at signalised intersections. However, the reduced complexity and perceived risk associated with single lane highways may result in turn signal neglect, as motorcyclists may be unaware of the necessity for self-protective behaviours (Rusli, Oviedo-Trespalacios, & Abd Salam, 2020).

The public perceives motorcycle riding as a dangerous activity. Motorcyclists themselves frequently observe that the vulnerability involved in riding a motorcycle causes danger, which is greatly mitigated by the rider's experience and skill, without sacrificing any of the excitement. While most motorcyclists advocate for safe riding, this is more disputed among non-motorcyclists. While motorcycle riders consider safety in

terms of being able to handle the bike and being aware of its limitations and capabilities, automobile drivers are less likely to view this as skill and may interpret it as resulting in irresponsible behaviour. However, perceptions of what constitutes safe riding vary significantly among motorcycle riders and are mostly determined by a calculated risk assessment (Musselwhite, Avineri, Susilo, & Bhattachary, 2012).

Motorcyclists and car drivers both have the same level of risk perception while driving. However, and perhaps most significantly, these two groups differ in their level of concern about this risk, with motorcycle riders being less worried about the likelihood of a road crash than automobile drivers. This indicates that the primary distinction between these two groups is not precisely related to perceived risk probability biases, but rather to the level of concern expressed about the risk's repercussions. This could result in a greater likelihood of risky driving behaviour among motorcycle riders than among car drivers (Cordellieri, Sdoia, Ferlazzo, Sgalla, & Giannini, 2019).

Motorcyclists frequently reported that other road users' attitudes toward motorcyclists, such as reckless driving or paying less attention to motorcyclists' presence, would almost certainly contribute to accidents. This is because motorcyclists have been accused of exaggerating their optimism, as though their safety is endangered by other motor vehicle users (Abdul Sukor, Zakaria, & Choy Peng, 2016).

2.4 Cyclists' Perceived Risk

Bicycles were introduced in the nineteenth century and have been and continue to be used for a variety of purposes, including recreation, work, military, show, and sport. In the United States, individuals ride bicycles to lose weight. Belgium, Australia, Japan, and Finland are among the top ten countries with the most bicycles per capita in the world. In Belgium, bicycles account for 8% of all trips. In Switzerland, 5% of regular

travels and 10% of work trips are performed by bike. Cycling is more than an exercise in that country; it is a healthy method to enjoy nature and the hospitality of the locals. In Japan, 15% of commuters arrive by bicycle, bicycles are frequently used as an alternative to automobiles, and many people cycle to railway stations. Today, an increasing number of Japanese commute by bicycle for health reasons and to avoid traffic jams and overcrowded trains. In Finland, bicycles account for 9% of all trips. In China, 60% of local cyclists in Shanghai commute daily. In Norway, bicycles account for 4% of all travel (Bernama, 2019).

Cyclists were more assured, less oblivious, and more supportive of tighter restrictions. The main effect of gender demonstrated that regardless of traffic role, women perceived higher risk than males as they perceived themselves to be less skilled and were more fearful of risks, suggesting that gender differences are not limited to cycling. Thus, perceived risk is similar for women who cycle regularly and those who do not (Griffin, Haworth, & Twisk, 2020).

Novice or intermediate cyclists exhibited increased risk perceptions of dangers encountered by cyclists when riding on the road network. cyclists viewed contacts with heavy cars as dangerous, particularly in terms of the severity of harm received in the event of a collision. For novice and intermediate cyclists, the perceived risk of dangers associated with interactions with motorised vehicles may cause them to avoid routes likely to encounter large vehicles (i.e., the most direct routes), cycle less frequently, or choose not to cycle at all. Gender may be a more accurate predictor of perceived dangers associated with cycling. While these findings suggest that perceived risk of riding hazards may vary according to cyclist characteristics (age, experience, and gender), they do not shed light on the reasons for these changes (Bill, Rowe, & Ferguson, 2015).

Young cyclists were shown to be more likely than older cyclists to believe cycling is less safe than driving. The perceived safety of cycling increases with frequency of use and the number of days cycled per week, increasing the likelihood of believing cycling to be less safe than driving (Lawson, Pakrashi, Ghosh, & Szeto, 2013). The finding that perceptions of bicycle crashes were related to self-reported crashes supported the importance of personal experiences. Those who had been engaged in a bicycle-motor vehicle collision identified this type of event as the leading cause of hospitalisation for riders (Schepers, de Geus, van Cauwenberg, Ampe, & Engbers, 2020).

Cyclists were more self-assured, less careless, and in favour of stronger regulations (Griffin, Haworth, & Twisk, 2020). Cyclists report considerably more bicycle accidents than motorists. Because cyclists fear collisions with motor vehicles more than collisions without motor vehicles, individuals may have been primed to think about bicycle collisions without motor vehicles rather than bicycle-motor vehicle collisions (Schepers, de Geus, van Cauwenberg, Ampe, & Engbers, 2020).

Female cyclists have a higher perceived crash risk than male cyclists (Griffin, Haworth, & Twisk, 2020). Although female cyclists were involved in fewer collisions than male cyclists, they were significantly overrepresented in cycling occurrences involving heavy goods vehicles. The majority of cyclists were aware of the relative hazards involved with each cycling manoeuvre, and risk perception predicted behavioural intention significantly (Frings, Rose, & Ridley, 2012). Both men and women assessed an overall danger for cyclists to be at least moderate, particularly in terms of collisions with other road users. Women perceived a larger risk than men, particularly of being run over by a car, which may account for women's preference for more separation from road traffic. However, whether cyclists' and non-cyclists' perceived risk of cycling corresponds to observed risk has generated controversy (Bösehans & Massola, 2018).

Perceived risk does not appear to affect injury rates, and injury rates do not appear to influence perceived dangers associated with cycling. Riders who view cycling as risky are less likely to be commuters, less likely to participate in group riding, more likely to always wear obligatory helmets and use front lights, and have a reduced opinion of risk when their riding days per week and percentage of riding on bicycle paths grow. Riders who constantly wear helmets have a lower probability of being injured in a mishap. Increased riding on a weekly basis is connected with a decreased risk of injury and non-crash injury. Increased exposure through increased riding days per week is connected with a lower risk of crash and non-crash injuries per kilometre travelled. Additionally, as is the case with automobile driving and motorcycle riding, increased exposure is related with a decrease in perceived risk when bicycling (Washington, Haworth, & Schramm, 2012).

It is remarkable that the installation of facilities at roundabouts and junctions has had little effect on cyclists' perceived risk or acceptability. This could be explained by individuals viewing the availability of facilities as indicating the presence of a hazardous scenario, but not as indicating that the amenities have eliminated the perceived hazard. The consequence is that providing amenities at a junction may have the opposite effect of implying to potential cyclists that the junction is more dangerous than it might otherwise be regarded. This has consequences for the promotion of bicycle use through the provision of on-road infrastructure. Additionally, the two-way motor traffic flow on the journey and the number of vehicles parked on the road increase the perceived risk of cycling (Parkin, Wardman, & Page, 2007). Conflicts while riding were substantially connected with the perceived probability of getting involved in an accident with a motorised vehicle. However, perceived likelihood of being engaged in other types of accidents (single accident, collision with a pedestrian, collision with another bicycle) was

unrelated to conflicts while cycling. A possible explanation is that a relatively small proportion of cyclists rated the danger of other sorts of accidents as high (i.e. those about which they were questioned). Because the majority of riders assessed the danger to be small, risk was unlikely to have influenced their behaviour (Kummeneje & Rundmo, 2020). Cyclists faced an elevated risk of being involved in a collision or near miss. Cyclists also report more collisions and near misses than drivers, which may be attributed in part to the differential chances offered by the fact that a cyclist is likely to face a high volume of motor vehicles, whilst a motor vehicle is likely to encounter fewer cyclists. Additionally, drivers are significantly more likely than cyclists to ascribe the incident to the cyclist's low visibility (Wood, Lacherez, Marszalek, & King, 2009).

CHAPTER 3

METHODOLOGY

3.1 Introduction

This chapter covers the methodology used to conduct this research and collect data before doing the analysis. Various steps have been taken in planning and implementing the identified works to ensure that the research may proceed as planned. The data for this study were gathered by questionnaire. The questions are separated by groups, with questionnaires for drivers, motorcyclists, and cyclists. A questionnaire is divided into two parts. For the first section, the respondents' basic demographic and personal characteristics were collected, including their gender, race, age, marital status, monthly income, highest level of education, employment status, driving experience, frequency of travel per week, average distance travelled per day, and average time spent travelling per day. Following that, 22 factors about risk perception are included in the questionnaire. After this step of getting the data, there was a stage of analyzing the data. The data was analyzed using the SPSS (Statistical Package for the Social Sciences) software. Figure 3.1 is a flowchart showing the steps used in this research.

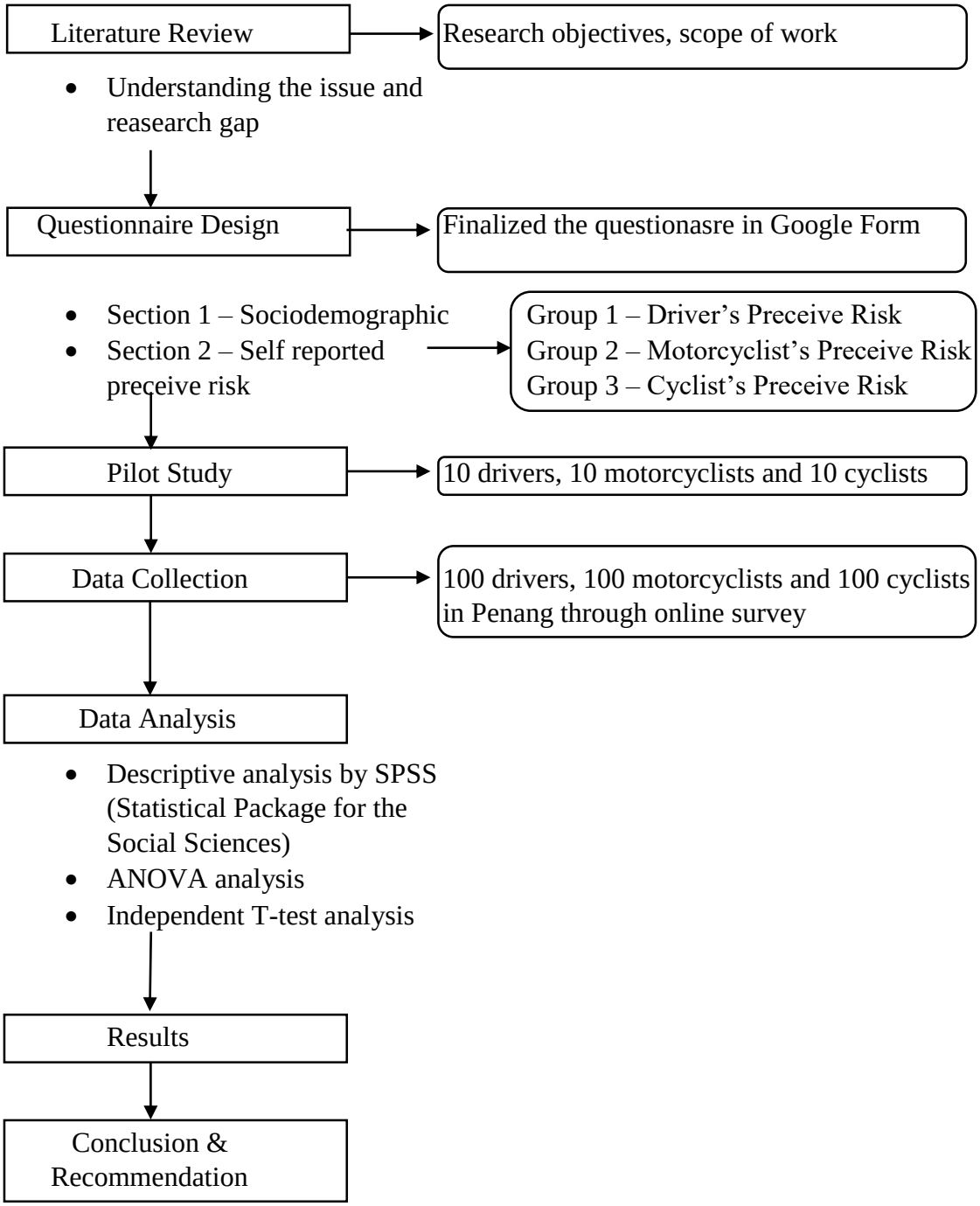

Figure 3.1: Flowchart of the study

3.2 Area of Study

This research is being conducted in the state of Penang. The state of Penang is divided into five districts: Daerah Timur Laut (126 square kilometers), Daerah Barat Daya (175 square kilometers), Daerah Seberang Perai Utara (268 square kilometers), Daerah Seberang Perai Tengah (238 square kilometers), and Daerah Seberang Perai Selatan (242 square kilometers) (Penang Institute, 2019). This location was chosen because of the mixed traffic in the area. As of June 2021, 2,778,681 private vehicles were registered in Penang, slightly more than double the state's population of 1.3 million. There were approximately 1.1 million cars, 1.5 million motorcycles, 4,823 buses, 4,111 taxis, 90,207 lorries, and 3,280 rental cars among the 2.7 million vehicles registered in the state. (Chan, 2021). There are around 1.7 million vehicles with active road taxes. (Chan, 2021). Besides, cycling has recently had a resurgence in popularity on Malaysian roads, especially for sport and recreation (Ministry of Transport Malaysia, n.d.).

3.3 Questionnaire Design

The study was conducted using an online questionnaire. A set of questionnaires was designed by adaptation and adoption from a previous study to ensure that the survey's objective could be accomplished. Several items have been adapted from Chaurand & Delhomme (2013). This questionnaire was designed in three versions: the first version was adapted for drivers; the second version was adapted for motorcyclists; and the third version was adapted for cyclists. The respondents will fill in the form based on their major mode of transport.

The first part of questionnaire asked about the respondent's sociodemographic characteristics. Gender, race, age, marriage status, monthly income, highest level of education, and employment status were all collected. The respondents were asked about

their riding or driving experience, the frequency with which they ride or drive per week, the average distance they ride or drive per day, and the average amount of time they spend riding or driving per day. Finally, they were asked about their perceived skill scale, and each of the 22 items included multiple choice responses to assist respondents in completing the questionnaire. The responses were rated on a seven-point scale ranging from 1 (totally disagree) to 7 (totally agree).

The questions A to P include the respondents have no problem adapting their driving, riding, or cycling to road surface conditions, the respondents drive, ride or cycle cautiously, when in the respondents' car, motorcycle or bicycle, they control their driving, riding or cycling no matter how heavy the traffic is, when in the respondents' car, motorcycle or bicycle, they control their driving, riding or cycling no matter how the weather is like, the respondents anticipate what other users will do, when in the respondents' car, motorcycle or bicycle, they control their driving, riding or cycling no matter how fast they are going, the respondents are sure of themselves when driving, riding or cycling, the respondents easily make their way between other vehicles, the respondents' driving, riding or cycling are efficient, the respondents can drive, ride or cycle well even when they are tired, the respondents have good reflexes, the respondents can get lost in their thoughts when driving, riding or cycling, the presence of someone with the respondents in the car, on the motorcycle, or behind them distracts them and deteriorates their driving, riding, or cycling, the respondents have trouble with night driving, riding or cycling, when the respondents are preoccupies, their driving, riding or cycling is affected and the respondents become careless when they are in a hurry.

The questions Q to V are different for the 3 different group and adopted to each scenario. For the driver respondents, the question include sometimes the respondents don't see motorcycles when on the road, sometimes the respondents don't see bicycle

when on the road, the respondents will reduce their speed when they see motorcycles on the road, the respondents will reduce their speed when they see bicycles on the road, the respondents will take a precaution when overtaking the motorcycles and the respondents will take a precaution when overtaking the bicycles. On the other hand, for the motorcyclist respondents, the question include sometimes the respondents don't see cars when on the road, sometimes the respondents don't see bicycle when on the road, the respondents will reduce their speed when they see cars on the road, the respondents will reduce their speed when they see bicycles on the road, the drivers will take a precaution when overtaking on the respondents and the respondents will take a precaution when overtaking the bicycles. Besides, for the motorcyclist respondents, the question include sometimes the respondents don't see cars when on the road, sometimes the respondents don't see motorcycles when on the road, the respondents will reduce their speed when they see cars on the road, the respondents will reduce their speed when they see motorcycles on the road, the drivers will take a precaution when overtaking on the respondents and the motorcyclists will take a precaution when overtaking on the respondents.

3.4 Pilot Study

Pilot studies have been performed to evaluate the practicality of the research study and the acceptability of the questionnaire among respondents. To begin, the questionnaire was distributed to 30 respondents: 10 drivers, 10 motorcyclists, and 10 cyclists.

The questionnaire items were chosen in accordance with the project's purpose. Following the pilot study, the final questionnaire was improvised by adding essential items and making minor changes. Monthly income is labelled with three distinct income

groups: the top 20% (T20), the middle 40% (M40), and the bottom 40% (B40). The questionnaire's theme is updated to a brighter colour. For cyclists, the range of average daily travel distances by bicycle is altered. Appendix A contains the final questionnaire of this study. All respondents' personal information was acquired anonymously. The self-reported method was chosen because it is highly convenient for respondents to respond. (Rhodes & Pivik, 2011).

3.5 Questionnaire Survey

The research is being carried out through the use of an online questionnaire survey. The questionnaire was shared through social media to reach more people. The drivers and the motorcyclists were recruited through social media group which relate to ‘Penangite’. The cyclists were recruited through the social media group which relate to ‘Penang Cyclist’. Besides, the respondents were recruited through the messages to the students and the administration staffs in Universiti Sains Malaysia Engineering Campus. The online questionnaire survey began on March 19, 2022, and completed on June 1, 2022.

3.6 Statistical Analysis

Analysis of data was done in accordance with the objective of this research. The data from the questionnaire were sorted in Microsoft Office Excel before analysed by using Statistical Package for Social Sciences (SPSS) Software. The descriptive analysis and t-test and ANOVA test were established through SPSS.