UNIVERSITI PUTRA MALAYSIA

DETERMINATION OF THE RISK FACTORS AND INJURY PROBABILITY FOR SMALL CAR CRASHES IN KLANG VALLEY, MALAYSIA

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By

VIVI SISILIA

Abstract of thesis Submitted to the School of Graduate Studies, Universiti Putra Malaysia, in Fulfilment of the Requirements for the Degree of Master Science

July 2007

DEDICATION

Especially dedicated to:

Papah, Mamah, Icha and Nanda
&
Teachers and Friends

Abstract of thesis presented to the Senate of Universiti Putra Malaysia in fulfilment of the requirement for the degree of Master of Science

DETERMINATION OF THE RISK FACTORS AND INJURY PROBABILITY FOR SMALL CAR CRASHES IN KLANG VALLEY, MALAYSIA

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July 2007

Chairman: **Wong Shaw Voon, PhD**

Faculty: **Engineering**

In year 2004, there was a study conducted for a report to the Ministry of Transport of Malaysia indicated that 40% of motorcyclists had access to motorcars as an alternative mode of transport. As a major mode of transport in Malaysia, motorcycle revealed about 48% of the registered vehicles in this country. The statistic compilation showed that number of motorcycles registered were increase from 3,564,756 in year 1995 to 6,164,953 in year 2003. Annual accident record showed that the percentage of motorcycles involved in road accidents recorded also increased by 10.3% from 86,834 in year 2002 to 95,545 in year 2003. In comparison, as a second major mode, the number of registered motorcars also experienced a high increase from 2,532,396 to 5,428,774 within the same period. And for the accident record, in the year 2002 alone, a total of 320,719 motorcars were involved in road accidents, representing an increase of 9.7%. At the end of year 2003, the total reached 351,832.

The growth of small car ownership in Malaysia has tremendously increased along with the tendency of changing the mode of transport from motorcycles to the safer type of vehicles. In the year 2003, 123,064 units of cars with engine capacity below 1000 cc were sold; 74,088 units for engine capacity 1301 cc – 1500 cc; 115,468 units for engine capacity 1501 cc – 2000 cc; 17,621 units for engine capacity 2001 cc – 2500 cc; and 6,884 units for cars with engine capacity 2501 cc – 3000 cc (JPJ, 2005). Along with the tremendous growth of vehicle ownership, especially motorcars, in Malaysia, the number of motorcars involved in road accidents has also alarmingly increased. However, the accidents involving motorcars continue to be a problem as the number has kept dramatically increasing in the last decade compared to the number of motorcycles involved in road accidents.

The study of risk factors and developing a prediction model on small car crashes were needed to address several matters such as: a) tremendous increase of registered motorcars which amplifying the rates of motorcar crashes; b) a need for understanding a small car crash patterns in order to reduce the severity of its occupants and highway looses; c) currently, different countries have different policies in categorizing the small car for example by fuel, engine capacity and weight, thus there is a need for a point of reference of small car specification and categories especially that small cars reveal as the highest number of cars travelling on the road in this country. To achieve the aforementioned aim, the objective of this study was established to determine what the risk factors for small car crashes in Malaysia are and to develop a statistical model based on Binary Logistic Regression for predicting the probability of injury and non-injury accidents involving small cars.

Fourteen hypotheses have been summarised from literature reviews and carried out into univariate and multivariate analyses to identify the risk factors and injury probability prediction model for small car crashes. Odds ratios have been using to determine the strength of association between the accident type and the risk factors. The accident type which was the dependent variable was categorised into two injury and non-injury accident. From the univariate analysis, the odds ratios determined that there were five risk factors of small car crashes that significantly caused injury to its drivers. Those risk factors were length of small car wheelbase, gender of small car driver, the utilization of seat belts, the changing of velocity after the impact, the extent of the damage, and the weight of the drivers. From the model development, all fourteen parameters tested using Binary Logistic Regression and the parameters sorted out into three significant small car crash predictors that causing higher probability of experiencing injury to the victims when exposed to accident. Those significant predictors were weight of the drivers, velocity changes and damage extent (χ^2=2.330, df=5, p<0.802). The model indicated that injury accident was more likely for small car which driver weighed 64kg and above, where the change of velocity 17km/h and above, and that where the extent of the damage reached extent scaled-2 and above.

Abstrak tesis yang dikemukakan kepada Senat Universiti Putra Malaysia sebagai memenuhi keperluan untuk ijazah Master Sains

PENENTUAN FAKTOR-FAKTOR RISIKO DAN KEBARANGKALIAN KECEDERAAN YANG DISEBABKAN PELANGGARAN KERETA KECIL DI KLANG VALLEY, MALAYSIA

Oleh

VIVI SISILIA

Julai 2007

Pengerusi: **Wong Shaw Voon, PhD**

Fakulti: **Kejuruteraan**

Statistik kekerapan utama pengangkutan di Malaysia menunjukkan 48 % pendaftaran kenderaan di negara ini adalah motosikal. Perbandingan menunjukkan jumlah pendaftaran kenderaan motokar juga meningkat 42 % selari dengan peningkatan kemalangan motokar dari 79,642 dalam tahun 1990 hingga 351,832 dalam tahun 2003 dalam tempoh yang sama (PDRM, 2003). Dalam tahun 2004, sebuah kajian yang dijalankan untuk kemudian direpotkan kepada Kementerian Pengangkutan Malaysia, menunjukan 40% motosikal mendahului kereta menjadi satu alternatif kekerapan pengangkutan. Oleh demikian, kebarangkalian untuk penukaran modal motosikal kepada kenderaan persendirian juga tidak mustahil.

Perkembangan pemilik-pemilik kereta kecil di Malaysia telah meningkat secara mendadak. Hal ini karena berlaku kecenderungan kekerapan pengangkutan motosikal yang bertukar menjadi pelbagai jenis kenderaan yang selamat. Dalam tahun 2003, 123,064 unit kereta dengan keupayaan enjin di bawah 1000 cc telah dijual; 74,088 unit dengan keupayaan 1301 cc – 1500 cc; 115,468 unit dengan

keupayaan enjin 1501 cc – 2000 cc; 17,621 unit untuk keupayaan enjin 2001 cc – 2500 cc; dan 6,884 unit kereta dengan keupayan enjin 2501 cc – 3000 cc (JPJ, 2005). Perkembangan yang mendadak ini menyebabkan pemilik kenderaan terutama pemilik motokar di Malaysia, jumlah motokar yang terlibat dalam kemalangan jalan raya. Akhir tahun 2003, jumlah kemalangan mencecah 351,832. Pada tempoh yang sama, peratus motosikal yang terlibat dalam kemalangan jalan raya meningkat 10.3 % dari 86,834 dalam tahun 2002 hingga 95,545 dalam tahun 2003. kesimpulannya, peningkatan kemalangan yang melibatkan motokar akan menjadi satu permasalahan yang serius berbanding jumlah kemalangan jalan raya yang melibatkan motosikal sepanjang akhir dekad ini.

Kajian mengenai faktor-faktor risiko dan pembuatan modal ke atas kemalangan kereta-kereta kecil diperlukan untuk mengenalpasti beberapa perkara seperti: a) Kajian ke atas pelanggaran kereta kecil di Malaysia. Ianya diperlukan untuk mengkaji potensi perubahan kekerapan pengangkutan dari motosikal ke motokar dan untuk mengurangkan bilangan kemalangan maut jalanraya per 10,000 kenderaaan. Tujuannya adalah untuk mencapai sasaran (Malaysia National Road Safety) dimana dua kematian kemalangan jalanraya per 10,000 kenderaan sehingga 2010 (MOT, 2006); b) Pada masa ini, setiap negara mempunyai perbezaan polisi dalam mengkategorikan kenderaaan kecil seperti keupayaan bahan bakar enjin dan berat; c) Faktor risiko kajian dan empirical modal telah membangun untuk pelanggaran kenderaan kecil sebagai arah tuju bagi membantu beberapa pihak. Misalnya seperti orang awam, dan/atau pihak professional termasuk pihak polis untuk meramalkan keperluan perkhidmatan ambulan bagi sesuatu kemalangan walaupaun sebelum pemeriksaan tahap kenderaan mangsa. Bagi mencapai matlamat, objektif kajian

telah ditentukan untuk mencari faktor risiko kemalangan kereta kecil di Malaysia dan membentuk model statistic berdasarkan (Binary Logistic Regression) bagi meramalkan kebarangkalian kecederaan dan tidak-kecederaan kemalangan yang melibatkan kereta kecil.

Hypotesis yang keempat-belas telah dijalankan meliputi univariasi dan multivariasi analisis untuk mengenalpasti faktor-faktor risiko dan meramalkan kebarangkalian kemalangan untuk modal pelanggaran kereta-kereta kecil. Hasil kajian merumuskan bahawa lima faktor risiko pelanggaran kereta kecil adalah disebabkan kemalangan melibatkan pemandu. Faktor-faktor itu termasuk, panjang jarak roda kereta kecil, jantina pemandu, pengunaan tali pinggang kaledar, perubahan kelajuan selepas impak, takat kerosakan dan berat pemandu. Hasil daripada model yang di bina, tiga faktor penyebab yang mempunyai kebarangkalian tertinggi adalah berat pemandu, perubahan kelajuan dan takat kerosakan.

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I certify that an Examination Committee has met on **18 July 2007** to conduct the final examination of Vivi Sisilia on her Master of Science thesis entitled "Determination of the Risk Factors and Injury Probability for Small Car Crashes in Klang Valley, Malaysia" in accordance with Universiti Pertanian Malaysia (Higher Degree) Act 1980 and Universiti Pertanian Malaysia (Higher Degree) Regulations 1981. The Committee recommends that the candidate be awarded the relevant degree. Members of the Examination Committee are as follows:

Prof. Dr. Sudhansu Shekhar Jamuar
Electrical and Electronic Engineering Department
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Prof. Ir. Dr. Barkawi Sahari
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HASANAH MOHD. GHAZALI, PhD
Professor/Deputy Dean
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Date:

This thesis submitted to the Senate of Universiti Putra Malaysia and has been accepted as fulfilment of the requirement for the degree of Master of Science. The members of the Supervisory Committee are as follows:

Wong Shaw Voon, PhD
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Radin Umar Radin Sohadi, PhD
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Universiti Putra Malaysia

Date:

DECLARATION

I hereby declare that the thesis is based on my original work except for quotations and citations which have been duly acknowledged. I also declare that it has not been previously or concurrently submitted for any other degree at UPM or other institutions.

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VIVI SISILIA

Date: 18 July 2007

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INTRODUCTION

1.1 Background

Reducing the number of motorcyclist road fatalities is often thought of as shifting the emphasis away from motorcycle riding to other safer modes of transport. As a major mode of transport in Malaysia, statistic compilations revealed that about 48% of the registered vehicles in this country are motorcycles. Consequently, annual motorcycle accidents over the last few decades had risen from 27,611 in the year 1990 to 95,545 in the year 2003. In comparison, the number of registered motorcars also experienced a high increase of 42% with a corresponding increase in motorcar accidents from 79,642 in the year 1990 to 351,832 in the year 2003 within the same period (PDRM, 2003). The comparison of the rate of registered motorcars and motorcycles can be seen in Figure 1.1.

A study conducted for a report to the Ministry of Transport (Ibrahim Seikh, A.K et al., 2004) concluded that the tremendous increase in the number of registered vehicles was followed by the tendency of changing mode of transport from motorcycles to motorcars as a safer mode. The study also indicated that 40% of

motorcyclists had access to cars as an alternative mode of transport. Therefore, the possibility of a modal shift from motorcycles to private cars is not impossible.

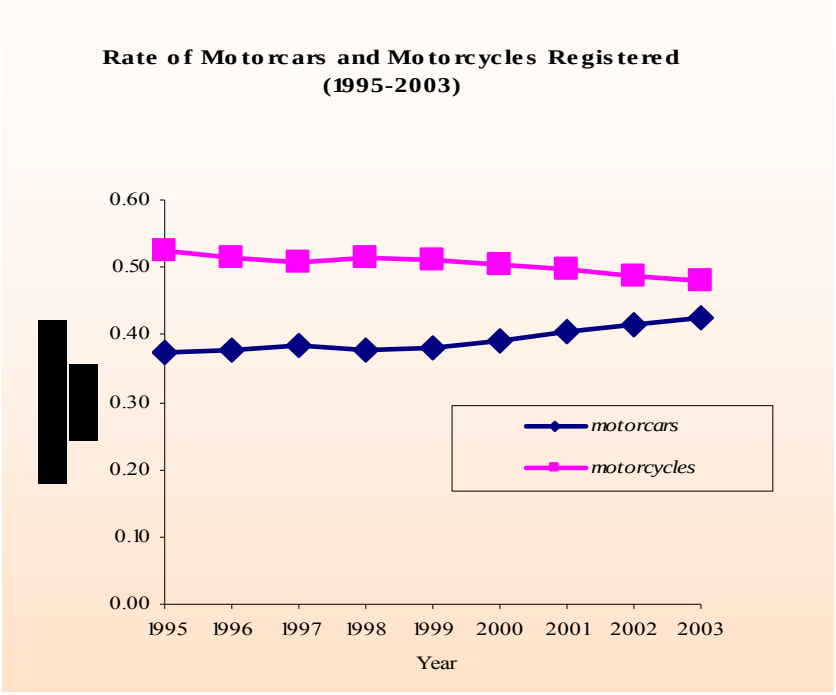

Figure 1.1: Rate of Motorcars and Motorcycles Registered in Malaysia (Source: Royal Malaysia Police (PDRM), 2003)

1.1.1 Growth in Small Car Ownership in Malaysia

The growth of small car ownership in Malaysia has tremendously increased along with the tendency of changing the mode of transport from motorcycles to the safer type of vehicles. In the year 2003, 123,064 units of cars with engine capacity below 1000 cc were sold; 74,088 units for engine capacity 1301 cc – 1500 cc; 115,468 units for engine capacity 1501 cc – 2000 cc; 17,621 units for engine capacity 2001 cc – 2500 cc; and 6,884 units for cars with engine capacity 2501 cc – 3000 cc (JPJ, 2005). The manufacturer of the national small car, Perodua (Perusahaan Otomobil Kedua) Sdn. Bhd., recorded that as at end March 2004 Perodua has successfully sold