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PREVALENCE AND DETERMINANTS OF STANDARD MOTORCYCLE CRASH HELMET USE AMONG RURAL POSTAL DELIVERY RIDERS IN PENINSULAR MALAYSIA

KAVIYARASU YELLAPPAN

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By

KAVIYARASU YELLAPPAN

Thesis Submitted to the School of Graduate Studies, Universiti Putra Malaysia, in Fulfillment of the Requirements for the Degree of Master of Science

December 2011

DEDICATIONS

I dedicate this work to:

The Almighty……

Lord Krsna

My lovely and supporting parents……

Yellappan Perumal
Sinnamah Govindasamy

My love and second half, beloved wife……

Nirmala Devi Tailan

My energetic young son…….

Haritharan Kaviyarasu

My siblings……

Kogilan Yellappan
Dinesh Yellappan
Tanes Yellappan
Hemes Yellappan

Thanks for all the support, guidance, patience, encouragement and faith.

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

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Chair : Kulanthayan K.C. Mani, PhD

Faculty : Medicine & Health Sciences

Motorcycle is the preferred mode of transport in developing countries and the most common vehicle involved in road crashes and fatalities. Head and neck injuries were leading cause of fatality among motorcyclists. Helmets were invented as a mechanism to prevent head injuries. Motorcycle was popular for commercial and leisure activities. Occupational motorcycle riders are known for using motorcycles regularly to work, during work and back from work. Based on records and literature, the history of involvement in crashes among occupational riders has not been recorded properly in Malaysia. Postal delivery riders (PDR) were seen as a vulnerable group compared they were exposed longer hours on the road than average of 2 hours daily during their delivery jobs. This study was designed to identify the determinants that influence the use of standard motorcycle crash helmets among rural postal delivery riders and determine the prevalence of used helmet that complied with helmet standard MS1:1996.

A cross sectional study was done among 269 PDR from 50 postal distribution centers throughout Peninsular Malaysia. Observation, interview and mechanical testing

method was used during data collection. Standards of motorcycle crash helmet were determined by presence of certification label issued by Standards and Industrial Research Institute of Malaysia (SIRIM) and by SIRIM helmet testing procedures. Descriptive, chi-square and bivariate logistic regression analyses were carried out using PASW Statistics version 18.

Prevalence of standard motorcycle crash helmet (*by presence of SIRIM label)* usage among postal delivery riders (PDR) were 76.6% with response rate of 99.3%. Analysis with presence of SIRIM label as a dependent variable resulted in odds of full shell motorcycle crash helmets having SIRIM label were 37.1 times than half shell helmets. Odds of non-purchased motorcycle crash helmets having SIRIM label were 14.9 times than purchased helmets. The odds of expensive motorcycle crash helmets to have SIRIM sticker were 4.4 times than cheaper motorcycle crash helmets. Motorcycle crash helmets owned by riders without previous crash history had 1.9 odds of having the SIRIM sticker than helmets owned by riders with crash history.

Prevalence of standard motorcycle crash helmet (*by SIRIM testing results)* usage among postal delivery riders (PDR) were 40% with response rate of 61%. In second analysis, SIRIM testing results was used as a dependent variable. The analysis revealed odds of non-purchased helmets to pass the SIRIM testing were 3.7 times the odds of purchased helmets that passed the test. Odds of motorcycle crash helmets with presence of SIRIM label to pass the SIRIM testing were 24.2 times the odds of standard motorcycle crash helmet without the presence of SIRIM label. Odds of

standard motorcycle crash helmet used (less than 2 years) to pass the SIRIM testing were 2.5 times the odds of the motorcycle crash helmet used (more than 2 years).

Arriving at the conclusion, employers should provide motorcycle crash helmets to the employees. Each helmet provided should be full shell motorcycle crash helmet with the presence of SIRIM label which indicates the helmet is a standard approved helmet. Helmets provided by employer should be purchased by the employer at a price of RM 35.00 or more. Respondents with prior crash history must be monitored closely on the helmet use pattern as they were less likely to wear standard helmets. Helmets used should be replaced once every two years to provide comfort and safety to the employees. As from PDR viewpoint, PDR should be educated and provided with knowledge of standard motorcycle crash helmet. PDR using the helmets provided by the employer were more safe than using own helmets. In the event, PDR not getting helmets provided by the employer, helmets purchased must have SIRIM certification sticker cost not less than RM 35.00 and should be replaced with new helmets every two years.

Key words: *expensive helmets; prior crash history; full shell helmets; non-purchased helmets and duration of helmet use.*

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

KELAZIMAN DAN FAKTOR-FAKTOR PENENTU PENGGUNAAN TOPI KELEDAR MOTOSIKAL PIAWAI DI KALANGAN PENGHANTAR POS BERMOTOSIKAL LUAR BANDAR DI SEMENANJUNG MALAYSIA

Oleh

KAVIYARASU YELLAPPAN

Disember 2011

Pengerusi : Kulanthayan K.C. Mani, PhD

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Motosikal merupakan pilihan pengangkutan di negara membangun dan kenderaan yang ketara terlibat di dalam kemalangan dan kematian jalan raya. Kecederaan kepala dan leher adalah penyebab utama kematian penunggang motosikal. Topi keledar telah dicipta sebagai mekanisme pencegahan kecederaan kepala. Motosikal amat popular untuk aktiviti komersial dan riadah. Penunggang motosikal pekerjaan sememangnya menggunakan motosikal untuk bekerja, bukan sahaja untuk pergi dan pulang bekerja malah semasa bekerja. Sejarah kemalangan penunggang pekerjaan tidak direkodkan dengan baik di Malaysia. Penghantar pos bermotosikal (PPM) dilihat sebagai kumpulan yang terdedah kepada bahaya kerana terdedah melebihi purata 2 jam sehari. Kajian ini direka untuk mengenalpasti penentu -penentu penggunaan topi keledar piawai di kalangan PPM luar bandar dan menentukan kelaziman penggunaan topi keledar yang mematuhi piawaian MS1: 1996.

Satu kajian keratan lintas telah dilakukan di kalangan 269 PPM daripada 50 pusat pengedaran pos di seluruh semenanjung Malaysia. Kaedah pemerhatian, temubual

dan pengujian mekanikal telah digunakan semasa pengumpulan data. Piawaian topi keledar motosikal telah ditentukan dengan kehadiran label pensijilan yang dikeluarkan oleh Institut Penyelidikan Piawai dan Industri Malaysia (SIRIM) dan prosedur ujian topi keledar SIRIM. Analisis deskriptif, *chi-sqaure* dan regresi logistik bivariat telah dijalankan dengan Perangkaan PASW versi 18.

Kelaziman penggunaan topi keledar motosikal berpiawai (dengan kehadiran label SIRIM) di kalangan PPM luar bandar ialah 76.6% dengan kadar respons 99.3%. Analisis dengan kehadiran label SIRIM sebagai pembolehubah bersandar menunjukkan topi keledar penuh memiliki kemungkinan 37.1 kali untuk mempunyai label SIRIM berbanding topi keledar separuh. Kemungkinan untuk topi keledar motosikal yang tidak dibeli mempunyai label SIRIM adalah 14.9 kali lebih tinggi berbanding dengan topi keledar yang dibeli oleh PPM. Kemungkinan untuk topi keledar motosikal yang mahal (RM 35.00 atau lebih) untuk mempunyai pelekat SIRIM adalah 4.4 kali lebih tinggi berbanding dengan topi keledar motosikal yang murah. Topi keledar motosikal yang dimiliki oleh penunggang tanpa sejarah kemalangan silam mempunyai 1.9 kemungkinan untuk mempunyai pelekat SIRIM berbanding topi keledar yang dimiliki oleh penunggang dengan sejarah kemalangan silam.

Kelaziman penggunaan topi keledar berpiawai (dengan keputusan ujian SIRIM) di kalangan PPM adalah 40% dengan kadar respons sebanyak 61%. Dalam analisis kedua, keputusan ujian SIRIM telah digunakan sebagai pembolehubah bersandar. Analisis ini mendedahkan kemungkinan untuk topi keledar yang tidak dibeli lulus ujian SIRIM adalah sebanyak 3.7 kali ganda lebih daripada topi keledar

yang dibeli untuk lulus ujian. Kemungkinan topi keledar dengan kehadiran label SIRIM untuk lulus ujian SIRIM adalah 24.2 kali kemungkinan topi keledar tanpa kehadiran label SIRIM. Kemungkinan topi keledar motosikal piawai yang digunakan (kurang daripada 2 tahun) untuk lulus ujian SIRIM adalah 2.5 kali lebih tinggi berbanding topi keledar yang digunakan (lebih daripada 2 tahun).

Kesimpulannya, majikan harus menyediakan topi keledar kepada pekerjanya. Setiap topi keledar seharusnya topi keledar penuh dengan kehadiran label SIRIM. Topi keledar yang disediakan oleh majikan harus berharga sekurang-kurangnya RM 35.00 atau lebih. Corak penggunaan topi keledar oleh pekerja dengan sejarah kemalangan silam mestilah dipantau kerana mereka mempunyai kemungkinan rendah untuk memakai topi keledar berpiawai. Topi keledar yang digunakan perlu digantikan setiap dua tahun sekali untuk keselesaan dan keselamatan para pekerja. Dari pandangan pekerja pula, mereka perlu dididik dengan pengetahuan topi keledar berpiawai. Pekerja digalakkan menggunakan topi keledar majikan kerana ia lebih selamat daripada topi keledar sendiri. Sekiranya majikan tidak dapat menyediakan topi keledar piawai, topi keledar yang digunakan oleh pekerja mesti mempunyai pelekat SIRIM. Harga topi keledar tersebut seharusnya tidak kurang daripada RM 35.00 dan hendaklah digantikan dengan topi keledar baru setiap dua tahun.

***Kata kunci**: topi keledar mahal; sejarah kemalangan silam; topi keledar penuh; topi keledar bukan dibeli dan tempoh penggunaan topi keledar.*

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I certify that a Thesis Examination Committee has met on 22nd December 2011 to conduct the final examination of Kaviyarasu Yellappan on his thesis entitled "Prevalence and Determinants of Standard Motorcycle Crash Helmet Use among Rural Postal Delivery Riders in Peninsular Malaysia" in accordance with the Universities and University Colleges Act 1971 and the Constitution of the Universiti Putra Malaysia [P.U.(A) 106] 15 March 1998. The Committee recommends that student be awarded the Master of Science.

Members of the Thesis Examination Committee were as follows:

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Date: 7 March 2012

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

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_____

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Date:

DECLARATION

I declare that the thesis is my original work except for quotations and citations which have been duly acknowledged. I also declare that it has not been previously, and is not concurrently, submitted for any other degree at Universiti Putra Malaysia or at any other institution.

KAVIYARASU YELLAPPAN

Date: 22 December 2011

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LIST OF ABBREVIATIONS

LMIC	Low and middle income countries
HIC	High income countries
WHO	World Health Organization
USA	United States of America
RMP	Royal Malaysian of Police
SIRIM	Standards and Industrial Research Institute Malaysia
PDR	Postal delivery riders
NHTSA	National Highway and Transport Safety Administration
DSM	Department of Statistics Malaysia
TRIPP	Transport Research and Injury Prevention Programme
ISS	Injury severity score
UK	United Kingdom
DOT	Department of Transport
ATV	All terrain vehicle
FMVSS	Federal Motor Vehicle Safety Standard
PDC	Postal delivery centers

CHAPTER 1

INTRODUCTION

1.1 Background

Road traffic injuries have been classified as a major community health issue globally (Sharma, 2008) especially in low and middle income countries (LMIC). There were many evidences and studies to show the losses of millions of lives on the road regardless of gender and age (Harrison et al., 1993; Clarke et al., 2005; Dandona et al., 2006; Mohan, 2008; Wong et al., 2010). Globally, total number of motor vehicles has reached one billion, mostly 80% in high income countries (HIC) and remaining 20% in LMIC (Wang, 2005) but only 10% of road traffic fatalities occurred in HIC and 90% in LMIC. According to World Health Organization (WHO), road traffic crashes would be an important global issue in next 20 years (Peden et al., 2004). This is an alarming issue and needs to be addressed quickly as road traffic casualties claim as many as 140,000 injuries worldwide daily and more that 3000 road users die and around 15,000 were disabled for life (Sharma, 2008).

It was noted in last World Report on Road Traffic Injury Prevention that motor vehicle crashes were the leading cause of fatality in workplaces in the USA and contribute significantly to the road fatality burden in other developed nations (Peden et al., 2004). Fatalities resulting from occupational disease and injury lay a heavy burden on community, in terms of monetary

costs and human agony (Steenland et al., 2003). Common age group to be involved in fatal crashes were mainly working age population (Mohan & Bawa, 1985). In a study done in USA using surveillance system data from 1980 to 1989, six leading causes of occupational mortality in USA were listed. First in the list was 23% of motor vehicle incidents followed by machine related injuries, homicides, falls, electrocutions, and being struck by falling objects. All these causes accounted for 72% of all occupational injury fatalities (Stout et al., 1996).

In a review conducted, road traffic fatality rates were found increased between 20% and 79% in Colombia, China, Botswana, Malaysia and India from 1975 to 1998 (Ameratunga et al., 2006). In most developing countries, motorcycles have been widely used as a common (Conrad et al., 1996), cheap, convenient (Supramaniam et al., 1984) and increasingly popular (Khan et al., 2008) form of transport. Unfortunately, these motorcycle users had an increasing cause of mortality, morbidity and disability (Wong et al., 1990a; Ankarath et al., 2002; O'Neill & Mohan, 2002; Peden et al., 2004). These figures greatly affect LMIC as majority of road users were motorcyclists. In Malaysia, based on Royal Malaysian Police (RMP) statistical report, there were 414,421 road crashes reported and 6,872 fatalities in year 2010 and 53% involves motorcyclists (RMP, 2011).

Motorcycle crash helmet were found able to reduce fatalities by 30 – 50% if worn properly (Bosch, 2006; TRIPP, 2006) and its usage could lessen the number of head injuries and hospital admissions (Conrad et al., 1996). Crash

helmet can reduce head and facial injury for persons of all ages in all types of collisions but it offers least degree of protection especially in high energy collisions (Meadows-Oliver, 2007). Studies conducted around the world had proven motorcycle crash helmets to be efficient in preventing head injuries if worn properly (Chenier & Evans, 1987; Rodgers, 1990; Bazarian, 2003). The early motorcycle helmets were designed accordingly with leather covered with shock absorbing liner. In later designs, the leather cover was replaced by a stiffer, plastic outer shell. The function of this shell was not only to prevent penetration, but also to distribute the impact load over a larger area (Bosch, 2006). Riders with properly fixed helmets were less likely to be dead or had developed difficulty in speech after a motorcycle collision. These retrospective supports the magnitude of motorcycle helmets in preventing functional disabilities related to head injury (Crompton et al., 2010).

The thickness of shell and protective padding in standard motorcycle crash helmet were thicker and able to provide more protection than non-standard motorcycle crash helmet. Non-standard motorcycle crash helmet usually lack one or more components used in manufacturing of standard motorcycle crash helmet. The Standards and Industrial Research Institute of Malaysia (SIRIM) is an independent authority to conduct researches, development, reviews and certification of all standards in Malaysia (Radin et al., 2005; SIRIM, 2011). Standard for the adult motorcycle crash helmet was the earlier standards published by SIRIM (Radin et al., 2005). Team members representing government agencies, trade commerce, manufacture association and scientific and professional bodies was formed to develop the standard (SIRIM, 1996).

The first standard drafted for motorcycle crash helmet was in 1969 (MS1:1969) and reviewed in 1988. Improvement was done to accommodate new testing trials and development of new helmet material requirement and was identified as MS1:1996: Specifications for Protective Helmets for Vehicle Users (SIRIM, 1996; Radin et al., 2005).

Declaration of standards of motorcycle crash helmet was done based on MS1:1996 from then onwards. It includes helmet impact attenuation test, penetration test and retention test. Sample of helmets were taken by SIRIM officers from the helmet manufacturing plant and sent to SIRIM testing facility. Standard labels were issued for all the motorcycle crash helmet that if all the samples passed the entire tests. Helmet manufacturers hold firmly to MS1:1996 standards in their production of motorcycle crash helmet to produce helmets that fits the standards as stipulated by SIRIM (SIRIM, 1996).

1.2 Problem Statement

Motorcycle riders often sustain multiple injuries and head injuries being the most frequent injury (Branas & Knudson, 2001; Lin & Kraus, 2009). Efficacy of motorcycle crash helmet in preventing head injuries have been proven through studies conducted globally (Chenier & Evans, 1987; Rodgers, 1990; Bazarian, 2003; Dee, 2009). Therefore it was a known fact that motorcycle crash helmet were efficient in reducing head injuries if worn properly (Ambak et al., 2011) but whether properly worn motorcycle crash helmet were able to provide equal protection as standard certified helmets remains a

question as very limited studies had explored this particular area (Peek-Asa et al., 1999; Kulanthayan et al., 2011).

In a retrospective study conducted in Taiwan using 2000 to 2002 hospital databases, higher percentage of pre-hospital deaths were reported in rural Taiwan compared with the urban areas. Delay in emergency medical service and transportation to nearest hospital were the contributing factors in higher rural pre-hospital deaths. Unrestrained rural motorcycle and car occupants also contributed to higher percentage of road traffic fatalities than urban counterparts (Li et al., 2008). A cohort study conducted in Taiwan from year 1994-1996 among 4729 junior college students also found that rural roads poses greater injury compared with urban roads (Lin et al., 2003a). Injury surveillance study conducted in few rural areas in Thailand also indicated non-compliance of helmet use among motorcyclists involved in crashes (Swaddiwudhipong et al., 1994)

According to Malaysia road accident statistical report published by RMP for year 2005 (RMP, 2006), the total number of fatalities by road crashes was concluded at 6200. Among these, 3181 were motorcyclists. In the same year, the total number of motorcyclist fatalities from working category was 1786 out of 3181 motorcyclists involved. Total fatalities involved 56% of working motorcyclists and contributed to major economic and emotional loss for the country and their families respectively. The RMP statistical report also showed that there were 5623 road crashes occurred by locality and almost 66.3% of crashes occurred in rural areas. In conjunction with these crashes,

2098 fatalities involved motorcyclists from rural areas (RMP, 2006). These local statistics indicated both occupational motorcyclists and rural areas were exposed to greater risk of road traffic fatalities.

After a preliminary observation was done among occupational motorcyclists, postal delivery riders (PDR) were found not using standard motorcycle crash helmet during their delivery routines despite being equipped with standard motorcycle crash helmet by the employer for their daily routines. PDR were also noticed to be exposed longer hours on the road during their delivery jobs (approximately four to six hours daily) during the observations.

1.3 Significance of Study

There were studies done on prevalence of helmet usage in Thailand (1995), Vietnam (2005) and China in 2010 (Swaddiwudhipong et al., 1998; Hung et al., 2006; Xuequn et al., 2011). Prevalence study was also carried out in USA in 1992 (Peek-Asa et al., 1999) and in Malaysia in 2006 (Kulanthayan et al., 2011) on non-standard helmet usage. This is the first study on prevalence of standard helmet use in Malaysia. The usage of standard motorcycle crash helmet has not been widely documented and their non-use represents a serious public health problem as helmet law repeal caused high mortality in USA (Knudson et al., 2004; Houston & Richardson, 2008). If indeed they were being widely used, then it would be important to determine why they were being used, as such knowledge might facilitate to identify factors to design intervention initiatives in future. A study on standard helmet usage among occupational motorcyclists especially from rural areas would

strengthen the understanding of helmet use behavior which could help alleviate the fatalities among occupational motorcyclists and in rural areas.

Determinants of standard motorcycle crash helmet usage found in this study would assist employers to use these determinants to ensure use of standard crash helmet usage among the motorcyclists and their safety while commuting to work and home. Despite being a guide for the employers to enhance road safety guidelines and practice among their employees, other occupational motorcyclists too can use these determinants to ensure the motorcycle crash helmets used for work adheres to the standard guidelines. Eventually, this would increase the usage of standard motorcycle crash helmet use among occupational motorcyclists in Malaysia especially in rural areas.

This study also marked an initial initiative taken towards studying standard motorcycle crash helmet use among occupational motorcyclists to ensure their safety on the road while carrying their daily tasks. This study also would help government road safety agencies and non-governmental organizations in develop policies pertaining to standard motorcycle crash helmet usage in respective road safety campaigns.

1.4 Objectives

1.4.1 General objective

The general objective of this study was to find the prevalence of standard motorcycle crash helmet use and identify the determinants that contribute to standard motorcycle crash helmet usage among rural postal delivery riders.

1.4.2 Specific objectives

1.4.2.1 To determine the prevalence of standard motorcycle crash helmet *(by presence of SIRIM label)* use among rural PDR in Peninsular Malaysia

1.4.2.2 To identify the socio demographic determinants *(age, education level, license ownership and knowledge score)* of standard motorcycle crash helmet *(presence of SIRIM label)* use among rural PDR in Peninsular Malaysia.

1.4.2.3 To identify the helmet determinants *(helmet type, helmet status and helmet cost)* of standard motorcycle crash helmet *(presence of SIRIM label)* use among rural PDR in Peninsular Malaysia.

1.4.2.4 To identify the occupational determinants *(working experience, distance traveled, time traveled and previous crash history)* of standard motorcycle crash helmet *(presence of SIRIM label)* use among rural PDR in Peninsular Malaysia.

1.4.2.5 To determine the magnitude of determinants associated with standard motorcycle crash helmet *(presence of SIRIM label)* use among rural PDR in Peninsular Malaysia.

1.4.2.6 To determine the prevalence of standard motorcycle crash helmet *(by SIRIM testing results)* use among rural PDR in Peninsular Malaysia

1.4.2.7 To identify the helmet determinants *(helmet status, presence of SIRIM label, duration of helmet use, type of chinstrap and helmet crash history)* of standard motorcycle crash helmet *(SIRIM testing results)* use among rural PDR in Peninsular Malaysia.

1.4.2.8 To determine the magnitude of determinants associated with standard motorcycle crash helmet *(SIRIM testing results)* use among rural PDR in Peninsular Malaysia.

1.5 Hypothesis

In this section, hypothesis tested in the study were listed.

1.5.1 Presence of SIRIM label is independent of age

1.5.2 Presence of SIRIM label is independent of education level

1.5.3 Presence of SIRIM label is independent of license ownership

1.5.4 Presence of SIRIM label is independent of knowledge score

1.5.5 Presence of SIRIM label is independent of helmet type

1.5.6 Presence of SIRIM label is independent of helmet status

1.5.7 Presence of SIRIM label is independent of helmet cost

1.5.8 Presence of SIRIM label is independent of working experience

1.5.9 Presence of SIRIM label is independent of distance traveled

1.5.10 Presence of SIRIM label is independent of time traveled

1.5.11 Presence of SIRIM label is independent of previous crash history

1.5.12 SIRIM testing results is independent of helmet status

1.5.13 SIRIM testing results is independent of presence of SIRIM label

1.5.14 SIRIM testing results is independent of duration of helmet use

1.5.15 SIRIM testing results is independent of type of chinstrap

1.5.16 SIRIM testing results is independent of helmet crash history

1.6 Conceptual Framework

Figure 1.1 below explains the determinants associated with the standard motorcycle crash helmet use. The concept focuses on three main characteristics that contributed towards the standard motorcycle crash helmet use. They were helmet, socio-demographic and occupational characteristics respectively.

Associated socio-demographic characteristics were age, education level, license ownership, knowledge score, ethnicity, license class, gender, location, marital status, lifestyle and income. As for this study, factors such as age, education level, license ownership and knowledge score were evaluated for its association with the respective dependant variable.

Helmet characteristics were important as it describes the information of the helmets being used in the study. They were helmet cost, helmet type, helmet

status, type of chinstrap, duration of helmet use, helmet crash history, presence of SIRIM label, comfortability, location of purchase, helmet brand and helmet color. Helmet cost, helmet type, helmet status, type of chinstrap, duration of helmet use, helmet crash history and presence of SIRIM label were evaluated and analyzed.

Occupational components that were found to be associated with the dependant variable were distance traveled in a day, time traveled in a day, working experience, previous crash history, type of road, type of motorcycle and load of work. In this study, variables studied were distance traveled in a day, time traveled in a day, working experience and previous crash history.

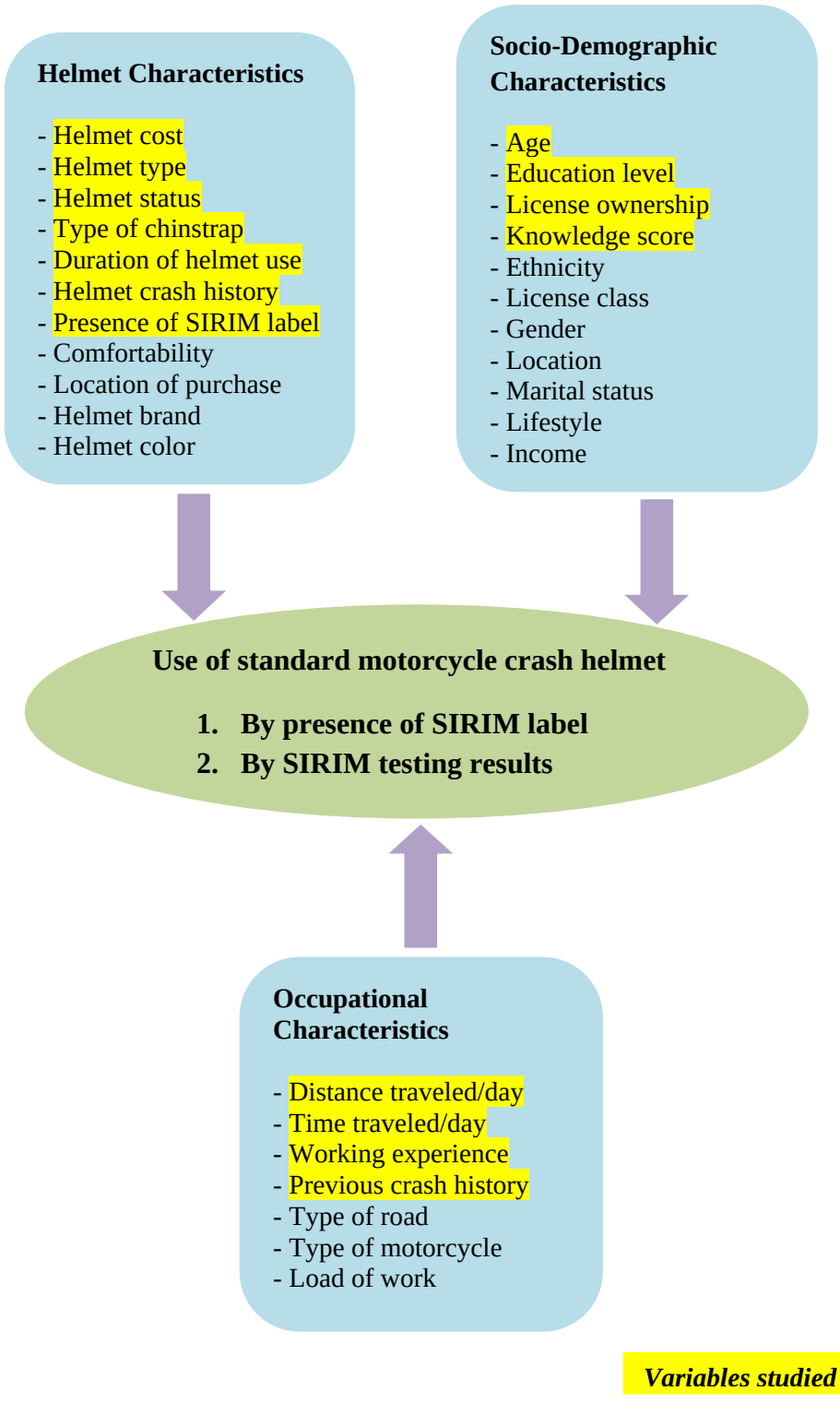

Figure 1.1: Conceptual Framework

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