FACTORS ASSOCIATED WITH HYPERTENSION STAGES AMONG MALAYSIAN ADULTS USING SECONDARY DATA FROM NATIONAL HEALTH AND MORBIDITY SURVEY 2015

BALKISH BINTI MAHADIR NAIDU

UNIVERSITI SAINS MALAYSIA

2018

FACTORS ASSOCIATED WITH HYPERTENSION STAGES AMONG MALAYSIAN ADULTS USING SECONDARY DATA FROM NATIONAL HEALTH AND MORBIDITY SURVEY 2015

by

BALKISH BINTI MAHADIR NAIDU

Thesis Submitted in Partial Fulfillment of the Requirements for the Degree of Master of Science

(MEDICAL STATISTICS)

UNIVERSITI SAINS MALAYSIA

2018

ACKNOWLEDGEMENTS

In the name of Allah, the Most Gracious and the Most Merciful

Alhamdulillah, all praises to Allah for the give strengths and His blessing in completing this thesis. I would first like to thank my thesis main supervisor, Assoc. Prof Dr. Sarimah Abdullah, the Coordinator of Unit Biostatistics and Research Methodology and my co-supervisor Assoc. Prof. Kamarul Imran Musa. The doors to Professor Sarimah and Professor Kamarul Imran was always open whenever I ran into a trouble spot or had a question about my research or writing. Both of them consistently allowed this research to be my own work, but steered me in the right the direction whenever they thought I needed it.

I would also like express my special thanks to Dr. Hj. Tahir Bin Hj Aris. Director of Institute for Public for being my mentor all-way long to be a researcher and statistician. I am gratefully indebted to the trust and confidence he put on me. Not to be forgotten, Dr Muhammad Fadhli Mohd Yusoff , Dr Noor Ani Ahmad and Dr Mohd Azahadi Omar who always open the door for discussion and help during my tough time.

To Riyanti Saari who were always there for me, Hatta Mutalip, Wan Shakira Wan Rodzlan, Hamizatul Akma, Dr Siti Zuraidah, Nor Azizah Ibrahim Wong and Nurdiyana Farhana for the endless moral and material support for this project .Without their passionate participation and input, the project could not have been successfully conducted.

To all biostatistics lecturers, Prof. Dr Norsaadah Bachok, Dr Siti Azrin ,Dr Najib, Dr Wan Nor Ariffin and Dr Erica. To my classmates, Chien Wei, Shirlie, KT, Fairul, Faza, Gee, Abdah and Fiza, Thank you for this wonderful 2 years. Thank you for the new knowledge and friendship.

I must express my very profound gratitude to my mom, Hajjah Zaiton, Hj Robert Khamis, my siblings (Ratna, Mala, Banu, Mumtaz, Ridhuan and Sarah) and to my spouse, Zulman Bin Ismail for providing me with unfailing support and continuous encouragement throughout my years of study and through the process of researching and writing this thesis. To my special dad and my three kids, thank you. This accomplishment would not have been possible without them.

Finally, I would like to thank the Director General of the Ministry of Health, Malaysia for permission to use the NHMS 2015 data.

Thank you.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF APPENDICES

LIST OF ABBREVIATIONS

AIC	Akaike Information Criterion
ALT	Alanine Aminotransferase
BMI	Body Mass Index
BP	Blood Pressure
CI	Confidence Interval
CS	Complex Sample
CPG	Clinical Practice Guideline
DBP	Diastolic Blood Pressure
DM	Diabetes Mellitus
HPT	Hypertension
JEPeM	Jabatan Etika Penyelidikan Manusia
LR	Likelihood Ratio
MC	Multicollinearity
NICE	National Institute for Health and Care Excellence
OR	Odds Ratio
PS	Power and Sample size software
ROC	Receiver Operating Characteristic
SBP	Systolic Blood Pressure
SD	Standard Deviation
SE	Standard Error

SPSS	Statistical Package for the Social Sciences
USM	Universiti Sains Malaysia
WHO	World Health Organization

LIST OF SYMBOLS

α	Level of significance
1-β	Power
p	Proportion
p	Probability
Δ	Precision
z	z-statistic distribution
n	Sample size
m	Ratio of control to cases group
δ	Estimated difference from population mean
σ	Standard deviation
P_0	Proportion of exposed factor in mild disease
P_1	Proportion of exposed factor in more severe disease
b	Regression coefficient
P	P-value
%	Percentage
=	Equal to
<	Less than
>	More than
≥	More than or equal to

≤	Less than or equal to
| |	Modulus
n	Covariate pattern
h	Leverage
dx2	Hosmer-Lemeshow Delta chi-squared influence statistic
dd	Hosmer-Lemeshow Delta-D influence statistic
db	Pregibon Delta-Beta influence statistic
K	Constant

FAKTOR BERKAITAN DENGAN TAHAP HIPERTENSI DALAM KALANGAN DEWASA DI MALAYSIA MENGUNAKAN DATA SEKUNDER DARI TINJAUAN KESIHATAN DAN MORBIDITI KEBANGSAAN 2015

ABSTRAK

Pengenalan: Tekanan darah tinggi adalah masalah klasik dunia dan kekal sebagai beban kesihatan global yang utama. Sama ada secara tunggal atau bergabung dengan penyakit metabolik lain,tekanan darah tinggi meningkatkan risiko penyakit kardiovaskular. Penyakit ini bertanggungjawab kepada 7.4 juta kematian disebabkan oleh penyakit jantung koronari dan 6.7 juta kematian disebabkan strok.

Objektif: Objektif kajian ini adalah untuk mengenalpasti prevalens dan faktor yang berkaitan dengan tahap hipertensi dalam kalangan orang dewasa di Malaysia.

Metodologi: Analisis data sekunder dari tinjauan keratan rentas menggunakan persampelan kluster berbilang lapisan berstrata dari Tinjaun Kesihatan dan Morbiditi Nasional 2015. Faktor demografi , parameter klinikal, ciri-ciri tingkah laku dan faktor risiko komorbiditi telah tersedia untuk analisis. Purata bacaan tekanan darah dikategorikan kepada empat kumpulan mengikut Laporan *The 7th Report of Joint Committee on Prevention, Detection, Evaluation and Treatment of High Blood Pressure (JNC7)* ialah Normal, pra-hipertensi, hipertensi tahap 1 dan hipertensi tahap 2.Regresi Logistik Ordinal Sampel Kompleks digunakan untuk analisis.

Keputusan: Sejumlah 15,738 orang dewasa telah dianalisis ini dengan purata umur 41.10 tahun (15.6 tahun). Prevalens pra hipertensi, hipertensi tahap 1 dan hipertensi tahap

2 adalah masing-masing 45.8% (95% SK: 44.66, 47.97), 15.1% (95% SK: 14.34, 15.92) dan 5.9% (95% SK: 5.44, 6.41). Faktor yang berkaitan dengan hipertensi yang lebih teruk dilihat di kalangan 30-39 tahun (Nisbah Odd = 1.68, 95% SK: 1.47, 1.93), 40-49 tahun (Nisbah Odd = 2.92, 95% SK : 2.53, 3.36), 50–59 tahun (Nisbah Odd = 4.67, 95% SK: 3.97,5.49), 60 tahun ke atas (Nisbah Odd = 8.09, 95% SK: 6.71, 9.76), luar bandar (Nisbah Odd = 1.15, 95% SK: 1.02,1.28), lelaki (Nisbah Odd = 2.15, 95% SK: 1.95, 2.38), bangsa Melayu (Nisbah Odd = 1.23, 95% SK: 1.07, 1.41), mempunyai pendidikan tidak formal (Nisbah Odd = 1.73, 95% SK: 1.37, 2.20) pendidikan sekolah rendah (Nisbah Odd = 1.41, 95% SK: 1.21, 1.64) (Nisbah Odd = 1.31, 95% SK: 1.12, 1.53), sudah berkahwin (Nisbah Odd = 0.86, 95% SK: 0.77, 0.98), perokok (Nisbah Odd = 0.84, 95% SK: 0.76, 0.94) (Nisbah Odd = 0.91, 95% SK: 0.83, 0.97), mempunyai diabetes mellitus (Nisbah Odd = 1.24, 95% SK: 1.10, 1.39) berlebihan berat badan (Nisbah Odd =2.06, 95% SK: 1.88, 2.26) dan obesiti (Nisbah Odd =4.58, 95% SK: 4.03, 5.21).

Kesimpulan: Analisis regresi pelbagai ordinal sampel kompleks menunjukkan usia, lokasi tempat tinggal, jantina, etnik, status pendidikan, status pendapatan, status perkahwinan, Diabetes Mellitus dan berlebihan berat badan dikaitkan untuk mempunyai hipertensi yang lebih teruk.

Kata kunci: Analisis data sekunder, Peringkat hipertensi, Kajian keratan rentas, Regresi Ordinal

FACTORS ASSOCIATED WITH HYPERTENSION STAGES AMONG MALAYSIAN ADULTS USING SECONDARY DATA FROM NATIONAL HEALTH AND MORBIDITY SURVEY 2015

ABSTRACT

Introduction: High blood pressure is a world's classic problem and remains a major global health burden. Either singly or combined with other metabolic diseases, high blood pressure increased the risk of cardiovascular diseases. The epidemic was responsible for 7.4 million deaths due to coronary heart disease, and 6.7 million deaths due to stroke.

Objective: The objectives of this study was to determine the prevalence of hypertension by stages and factors associated with hypertension stages among the adult population in Malaysia.

Methods: The study used secondary data from the nationwide cross-sectional population-based survey using multistage stratified cluster sampling of the National Health and Morbidity Survey 2015. Socio-demographic factors, clinical parameters, behavioural characteristics and comorbidities risk factors were available for analysis. The average blood pressure reading was categorised to four groups according to The 7th Report of The Joint Committee on Prevention, Detection, Evaluation and Treatment of High Blood Pressure (JNC7) (normal, prehypertension, stage 1 hypertension and stage 2 hypertension). Complex Sample Ordinal Logistic Regression was used for analysis.

Results: A total of 15,738 adults were included in the study with the mean age of 41.10 years (15.6 years). The prevalence of prehypertension, stage 1 hypertension and stage 2

hypertension were 45.8% (95% CI: 44.66, 47.97), 15.1% (95% CI: 14.34, 15.92) and 5.9% (95% CI: 5.44, 6.41), respectively. Factors associated with more severe hypertension were observed among those in 30–39 years old (OR = 1.68, 95% CI: 1.47, 1.93), 40–49 years old (OR = 2.92, 95% CI: 2.53, 3.36), 50–59 years old (OR = 4.67, 95% CI: 3.97, 5.49), 60 years old and above (OR = 8.09, 95% CI: 6.7, 9.76), rural residents (OR = 1.15, 95% CI: 1.02, 1.28), male (OR = 2.15, 95% CI: 1.95, 2.38), the Malays (OR = 1.23, 95% CI: 1.07, 1.41), had non-formal education (OR = 1.73, 95% CI: 1.37, 2.20), had primary education (OR = 1.41, 95% CI: 1.21, 1.64), had low income (OR = 1.31, 95% CI: 1.12, 1.53), married person (OR = 0.86, 95% CI: 0.77, 0.98), current smoker (OR = 0.84, 95% CI: 0.76, 0.94), were physically inactive (OR = 0.91, 95% CI: 0.83, 0.97), had Diabetes Mellitus (OR = 1.24, 95% CI: 1.10, 1.39), being overweight (OR = 2.06, 95% CI: 1.88, 2.26) and being obese (OR = 4.58, 95% CI: 4.03, 5.21).

Conclusion: Complex Sample Ordinal regression analysis revealed that age, locality, gender, ethnic, income, educational level, marital status, Diabetes Mellitus and BMI were the independent factors associated with severity of hypertension.

Keywords: Secondary data analysis, Hypertension stages, Cross sectional, Ordinal Regression

CHAPTER 1: INTRODUCTION

1.1 Background

High blood pressure is a world's classic problem and remains a major global health burden. Either singly or combined with other metabolic diseases, such as diabetes and obesity, high blood pressure increased the risk of cardiovascular diseases such as stroke and ischemic heart diseases (Chobanian *et al.*, 2003; Lozano *et al.*, 2013). The past decade has seen the rapid development of high blood pressure research in many countries (WHO, 2002; Lim *et al.*, 2013).

Approximately, 40% of adults aged 25 years and above in the world had been clinically diagnosed to have hypertension. An estimate of 17.5 million people died from cardiovascular diseases in a year, representing almost one-third of total deaths (WHO, 2008). Meanwhile, published work of clustering cardiovascular burden of disease study in 21 regions highlighted that more than nine million of deaths were due to the complications of hypertension (Lim *et al.*, 2013). This epidemic was also responsible for 7.4 million deaths due to coronary heart disease and 6.7 million deaths because of stroke (WHO, 2011a; Lim *et al.*, 2013). An excellent work from NCD Risk Factor Collaboration (NCD-RisC) on worldwide trends of raised blood pressure from 1975 to 2015 using 1479 population-based study highlighted that numbers of adult with hypertension rose from 594 million in 1975 to 1.13 billion people in 2015 (NCDRisC, 2017). According to WHO, by 2025, almost 1.56 billion (29.2%) people are projected to have hypertension (WHO, 2002).

Hypertension especially uncontrolled and untreated hypertension is associated with increased risk of total and cardiovascular mortality among the general hypertensive population (Gu *et al.*, 2010). Extensive research on the effect of potentially modifiable risk factors for myocardial infarction in large-scale data (52 countries) proved that those who have severe raised blood pressure increase the risk of having myocardial infarction by 2.5 times compared to those with normal blood pressure regardless of ethnic, sex and smoking status (Yusuf *et al.*, 2004). Not only had those with clinical hypertension but it marked that individual in the prehypertension group is more likely to develop the cardiovascular disease by at least 1.5 times compared to those who were normal (Liszka *et al.*, 2005; Qureshi *et al.*, 2005; Wang *et al.*, 2006). This evidence was earlier supported by a 34-years follow up of the Framingham Heart Study cohort indicating that the risk of congestive heart failure was more than two times higher for those who were in the higher quintile of blood pressure compared to the lower quintile during beginning of the study (Kannel and Belanger, 1991).

Asia faces a large threat of an epidemic of hypertension specifically in the highly industrialised countries. In the year of 2000, over 180 million people in China were estimated to have hypertension and by the year 2025, it was estimated that this number will increase by about 100 million people from 2000 (Kearney *et al.*, 2005), however, a recent study from NCD Risk Collaboration (2017) highlighted the current burden has already exceeded the projection. Approximately more than 40% of 1.13 billion adults with hypertension live in Asia in 2015, and 226 million alone of whom are in China (NCDRisC,

2017). In Malaysia, it was estimated nearly four million people in 2006 had clinical hypertension, and after almost 10 years the number rose to more than six million. Despite all the campaigns carried out and recommendations done, the number keeps rising and ironically, half of the population affected were not aware of their health condition (IPH, 2008; IPH, 2011; MOH, 2014). A meta-analysis of one million adults from 61 prospective studies showed that if the disease is left uncontrolled and untreated, it will lead to one of its serious complication, such as ischemic heart disease, stroke, renal failure, blindness and myocardial infarction (Lewington S, 2002).

A national representative survey involving more than 30,000 Malaysian adults in 2006 indicated that only 68% of adults population were in healthy blood pressure group, however half of them were at risk of being hypertension (IPH, 2008). Recent evidence revealed that one out of three Malaysian adults were suffering from clinical hypertension and this trend has not changed for the past decade (IPH, 2008; IPH, 2011; IPH, 2015a). Existing research population based in Malaysia showed that hypertension was relatively higher in men, older age group and those with low household income (Rampal *et al.*, 2008). It was also found that there is a difference between factors associated with pre hypertension, stage 1 hypertension and stage 2 hypertension (Chiu *et al.*, 2006; Gebreselassie and Padyab, 2015).

Hypertension is a relatively high-cost disorder. The economic burden to the nation was well established and discussed (Bloom *et al.*, 2011). According to Lyold et. *al*, the US government had spent more than 174 million dollars for this chronic disease (Lloyd-Jones

et al., 2010). As in Malaysia, Amrizal and colleagues highlighted the expenses of the government healthcare provider for managing hypertension patients admitted to government hospital almost Ringgit Malaysia 100 million in a year, and the cost for antihypertensive alone was more than Ringgit Malaysia 200 million (Amrizal *et al.*, 2005). Not only the expenses of healthcare increased for the country, it will definitely affect the hypertensive individuals and their families in terms of lost productivity and reduced quality of life (Wang *et al.*, 2006; WHO, 2011b). However, many complications of hypertension can be delayed or prevented by effective treatment and education. Strong evidence showed that reducing the blood pressure by lifestyle modification and a combination of drug therapy could lower the chance of having cardiovascular diseases (Mancia *et al.*, 2007; WHO, 2011a; MOH, 2014; WHO, 2015).

Based on the widely used Framingham study, normotensive blood pressure people had longer life expectancy by five years compared to people with hypertensive blood pressure (Franco *et al.*, 2005). Previous research has established that patients with stage 2 hypertension required greater reductions in blood pressure than patients in stage 1 in order to have a stable quality of life (Ueshima *et al.*, 2000). In line with the finding, proven evidence by Ogden *et al.* that lowering blood pressure could reduce the stroke incidence by at least 25% and myocardial infarction by at least 20% (Ogden *et al.*, 2000).

Hypertension is a condition in which the blood vessels persistently raised pressure. According to The 7th Report of Joint Committee on Prevention, Detection, Evaluation and Treatment of High Blood Pressure (JNC7), a person with systolic blood pressure

(SBP) range 120—139 and/or diastolic blood pressure (DBP) range 80–89 is defined as having prehypertension, those with SBP range from 140–159 and/or DBP range 90–99 is defined as having stage 1 hypertension while those with SBP ≥ 160 and/or DBP ≥ 100 is defined as having stage 2 hypertension (Chobanian *et al.*, 2003).

1.2 Problem Statement

In Malaysia, over the past decades, the prevalence of hypertension remained high and there is no significant improvement in the community despite all policies and hypertension task force that had been implemented by the government (IPH, 2008; IPH, 2011; MOH, 2014).

In addition, most of the previous studies were focused on hypertension among adults and its associated factors. But these did not give much clue regarding factors associated with the disease according to its severity and most importantly among the vulnerable prehypertensive group. Based on current knowledge, information on the severity of hypertension by stages and the factors associated with the severity has not well established in Malaysia. Although prehypertension has not yet considered a disease category, an early detection of it could prevent future risk of developing hypertension and other cardiovascular diseases by modification of lifestyle as suggested in JNC7 and Malaysian Clinical Hypertension (CPG) guideline (Chobanian *et al.*, 2003; MOH, 2014).

Moreover, previous evidences had highlights the importance of identifying the severity of hypertension. As for example, finding based on the widely used Framingham study showed normotensive blood pressure people had longer life expectancy by five years compared to people with hypertension stage 1 and hypertension stage 2 (Franco *et al.*,

2005). In addition, according to Ueshima *et al.*, patients with stage 2 hypertension required greater reductions in blood pressure than patients in stage 1 in order to have a stable quality of life (Ueshima *et al.*, 2000). In line with other findings, proven evidence by Ogden *et al.* showed that lowering blood pressure could reduce the stroke incidence by at least 25% and myocardial infarction by at least 20% in those with stage 1 and stage 2 hypertension (Ogden *et al.*, 2000).

According to Malaysia Clinical Guideline for Hypertension, 2014, a key component to ensure the blood pressure in the control level was tailored therapeutic regime according to the hypertension stages and their co-existing risk factors (MOH, 2014).

1.3 Justification of the Study

This study would provide the prevalence of hypertension by stages among adults. Presently, to current knowledge, there is no similar study done on the severity of hypertension in the local setting, thus this study produce the estimated population prevalence according to its severity group (pre-HPT, stage 1 HPT and stage 2 HPT). Moreover, there are significantly increasing numbers of those who have borderline hypertension (prehypertension) among adults worldwide. In line with the 6^{th} global non communicable disease (NCD) target during the World Health Assembly 2013 that to reduce 25% of prevalence of raised blood pressure by 2025, a comprehensive, and consistent nationwide data is needed to understand the pattern of high blood pressure in Malaysia (WHO, 2013b).

This study would also offer some important insights of the severity of hypertension in the local population. Quantifying the potential factors associated with different hypertension