ORIGINAL ARTICLE

RISK FACTORS OF NEWLY DIAGNOSED HYPERTENSION AMONG INDIVIDUALS IN MALAYSIA

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ABSTRACT

The aim of this study is to examine the influence of risk factors which include modifiable and non-modifiable risk factors on the likelihood of newly diagnosed hypertension among Malaysians. A cross-sectional population-based survey: The Fourth National Health and Morbidity Survey (2011) was conducted by the Ministry of Health, Malaysia in 2011. The sample included 20,095 participants. This study uses binomial logistic regression techniques to predict the likelihood of modifiable and non-modifiable risk factors of newly diagnosed hypertension among the individuals. The analysis has been carried out by estimating odds ratio with 95% confidence interval. This study reveals that obese and overweight respondents as well as current drinkers have increased chances of having newly diagnosed hypertension. In contrast to that, only physically inactive respondents exhibit lower odds of newly diagnosed hypertension. Besides that, the significant predictors, which include older respondents, retirees and home makers, as well as lower educated respondents are respectively found to be more likely to have newly diagnosed hypertension. On the other hand, female respondents, urban dwellers, including the Chinese and Indian respondents, the highest income earners and underweight respondents have been found to have statistically significant lower odds of newly diagnosed hypertension. Through the insightful findings and evidence, this research provides a platform for the early detection and prevention of newly diagnosed hypertension. Hence, this study offers a means to monitor and control the increasing prevalence of newly diagnosed hypertension in Malaysia.

Keywords: *Newly diagnosed hypertension, prevention, modifiable risk factors, non-modifiable risk factors*

INTRODUCTION

Hypertension (HP) has been identified as the leading risk factor for global disease burden[1]. Number of individuals with hypertension in developing countries have been estimated to be approximately 1.17 billion. This represents almost three-fourths of the world's hypertensive population[2]. Although Malaysia has begun its Healthy Lifestyle Campaign back in 1991, there has been no significant decrease in the prevalence of hypertension. For example, about RM215.9 million was spent on anti-hypertensive medicines alone in year 2005 in Malaysia[3].

In addition to that, it was reported that there were 37,580 hypertension-related admissions to government hospitals. This serves as an evidence that Non-Communicable Diseases patients are burdened by the high treatment cost[4]. Besides that, it was found that the prevalence of newly diagnosed hypertension was 19.8% (95% CI: 19.0-20.7). The figure was higher compared to that of the prevalence of known hypertension which was 12.8% (95% CI: 12.2-13.5) among adults above 18 years.

Evidently, newly diagnosed hypertensive patients have greater opportunity of developing known Hypertension[5]. Since hypertension has a silent nature, early identification of the newly diagnosed hypertension will help to prevent and reduce the progression of this disease to known hypertension, which consequently may lead to serious complications, including stroke and heart disease[6]. Thus, early detection of newly diagnosed hypertension may aid in reducing the new additions to known hypertension and also act as a safeguard against an alarming increase in the total prevalence of hypertension status in the country. As a result, it is essential to investigate and estimate the odds ratio of modifiable and non-modifiable risk factors among the newly diagnosed hypertensive individuals in Malaysia. This will help to identify the potential predictors that can be used to assist the government in preparing early detection of the prevalence newly diagnosed hypertension programmes. These initiatives will thus assist in preventing the occurrence of hypertension in Malaysia.

Previous literature has revealed that, among the urban Chinese adults, physical inactivity was significantly associated with increased odds of

newly diagnosed hypertension[7]. Similarly, it was also found that frequent alcohol consumption increased the probability of hypertension (OR = 1.25, CI = 1.04-1.52, *P* < .01) in China[8]. In addition to that, smoking has been identified to have statistically significant association (p<0.001) with hypertension[9]. However, high fruit and vegetable intake was found to be inversely associated with blood pressure levels in a Mediterranean population who exhibited higher tendency of consuming fat. After adjusting for hypertension and other dietary exposures, it exhibited the prevalence odds ratio with 0.23 (95% CI 0.10-0.55; P=0.001) by comparing those in the highest quintile of both fruit and vegetable consumption with those in the lowest quintile of both food groups[10]. Furthermore, it has been found that obesity is linked to elevated blood pressure, salt-sensitivity, as well as glucose intolerance and dyslipidemia[11].

With regard to non-modifiable risk factors, females were found to have 39.3% prevalence of newly diagnosed hypertension, which was slightly higher than that of males (36.7%)[6]. However, among the Chinese urban adults in China, males were found to be related to increased odds of getting newly diagnosed hypertension[7]. Similarly, it has been reported that there was significant association between newly diagnosed hypertension and increasing age ($p < 0.05$)[6]. Besides that, it was observed that the illiterate with lower educational status had higher prevalence (34.9%) of newly diagnosed hypertension[12]. Likewise, with respect to residential area in China, it was found that urban adults had a higher probability of being hypertensive (OR=1.19, $p < .1$)[8]. In contrast to that, it was found that the prevalence of hypertension was significantly higher among the rural dwellers than among the urban dwellers (31.3% vs 29.2%, p=0.001)[13]. Lastly, it was revealed that the respondents with higher income had lower odds (OR=0.71, 95% CI=0.56 - 0.91) of getting newly diagnosed hypertension[7].

METHODOLOGY

Sample

This research involves 20,095 eligible respondents. The data was based on the secondary data from The Fourth National Health and Morbidity Survey (NHMS IV) and was analyzed by using binomial logistic regression. The target population of this survey covered both urban and rural areas of every state in Malaysia. The selection criteria were determined by the Ministry of Health Malaysia. The target population consists of all non-institutionalized individuals residing in Malaysia for at least 2 weeks prior to data collection. Institutional population such as those staying in hotel, hostels, hospitals etc. has been excluded from this survey.

The sampling frame of The Fourth National Health and Morbidity Survey was provided by the Department of Statistics Malaysia. Based on the sampling frame of this survey which was updated in year 2010 prior to the National Population and Housing Census 2010, Malaysia was divided into Enumeration Blocks (EB) which were geographically continuous areas with identified boundaries. There were approximately 75,000 EBs in Malaysia in the year 2010 and each EB had between 80 to 120 Living Quarters with an average population of 500 to 600 people. The EBs in the sampling frame were classified into either rural or urban areas by the Department of Statistics based on the population size of gazetted and built-up areas. A two-stage stratified sampling design was used to ensure national representativeness. A total of 794 EBs were selected from the total EBs in Malaysia, where 484 and 310 EBs were randomly selected from urban and rural areas respectively[14]. Additionally, structured questionnaires, along with face-to-face interviews as well as administered methods were used by the Ministry of Health, Malaysia to collect data. This study has been approved by the Medical Research Ethical Committee (MREC), Ministry of Health Malaysia (NMRR-12-324-11225).

Variables

The analysis has been performed by using binomial logistic regression to identify factors which influence the likelihood of having newly diagnosed hypertension. The binomial logit model is used to estimate the odd ratios (95% CI). Under this modeling approach, the dependent variables are classified into two categories: 0 = "No newly diagnosed hypertension" and 1 = "newly diagnosed hypertension". The dependent variable, newly diagnosed hypertension has been demonstrated in the equation as the logarithm of the odds which indicates that a risk factor has been predicted. The Fourth National Health and Morbidity Survey (NHMS) 2011 survey report has defined newly diagnosed hypertension as not known to have hypertension and has an average systolic blood pressure equal to or more than 140 mmHg and/or diastolic blood pressure equal to or more than 90 mmHg.

Meanwhile, the independent variables include Body Mass Index (BMI) which comprises of Body Mass Index (BMI): overweight (BMI > 18.5 kg/m^2), obesity (BMI ≥ 30.00 kg/m^2) and underweight (BMI < 18.5 kg/m^2). Individuals with normal BMI (18.5 -24.99 kg/m^2) has been identified as the reference category. Additionally, physical inactivity (inactive and active), fruit and vegetables consumption (inadequate and adequate), drinking status (unclassified, current drinker, ex-drinker and non-drinker) and smoking status (current smoker, ex-smoker and non-smoker) are included in the regression model.

Next, the independent variables (non-modifiable risk factors) which include education levels (unclassified, no formal, primary, secondary and tertiary), age (above 65 years, 55-64 years, 45-54 years, 35-44 years, 25-34 years, 15-24 years and below 15 years), household income (above RM7,000, RM5,001-RM7,000, RM3,001-RM5,000,RM1,501-RM3,000, RM0-RM1,500), marital status (widow/widower/divorced, married and single), gender (female and male), residential area (urban and rural), race (others, other Bumiputra, Indian, Chinese and Malays) and occupation (retiree, home maker, self-employed, private and Government/semi government) have been entered in the regression equation and the results have been obtained by comparing them with the reference category.

The independent variables have been selected using the significance test of the overall model, goodness-of-fit measures and validation of predicted probabilities using odds ratio. The verification for multicollinearity has been conducted by using Variance Inflation Factor (VIF), correlation matrix, and the standard error. Since the Variance Inflation Factor has been found to be less than 10 (VIF values <10), it has been concluded that no collinearity existed among the independent variables in the binomial logistic regression model. The statistical analysis has been done using the Statistical Package for Social Science (SPSS, Inc., Chicago, IL; version, 23.00). Similarly, Chi-square test has been conducted to assess the independent variables which consists of modifiable and non-modifiable risk factors.

Binomial Logistic Regression Model

The risk factors of newly diagnosed hypertension have been assessed using the binomial logit model (BLM) in which the outcome variables consist of two categories. The independent variables have been coded as 1 to be the *EVENT* (suffer from newly diagnosed hypertension) and as 0 to be *[1-EVENT]*, indicating no newly diagnosed hypertension. The logistic regression function can be written as follows:

$$\text{Prob [}Event\text{]} = \frac{1}{1+e^{-z}} \quad (1)$$

where $Z = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \ldots + \beta_k X_k + \varepsilon$

Z is a latent variable and is not real. The Z function is transformed to obtain either probability of the *EVENT* occurring or [1-*EVENT*] if not occurring. The probability of an event which is not occurring is estimated as:

$$\text{Prob [No event]} = 1 - \text{Prob [Event]} \quad (2)$$

A binomial response variable *Y* which consists of two outcome variables and takes value of 1 as 'success' outcome (π) and 0 as 'failure' outcome (1- π). In the context of this study, Y_i equals to 1 if respondents have newly diagnosed hypertension and 0 if not.

$$P\{Y_i = 1\} = \pi = \frac{exp(\beta' X_i)}{1+exp(\beta' X_i)} \quad (3)$$

with $\beta' X_i = \beta_0 + \beta_1 X_{i1} + \beta_{p-1} X_{i,p-1}$. β_k is the parameter of the model. When Y is the outcome variable and x_i is the value of independent variable *i*, the logistic regression model predicts the logit of *Y* from *X*. The logit is the natural logarithm (ln) of odds of *Y*. This model is not linear. Through the logit transformation, the multiple binomial logistic model is transformed as follows:

$$\pi' = \ln\left[\frac{\pi}{1-\pi}\right] = \ln(\text{odds}) \quad (4)$$

The model tangible to a linear model that creates logit response function is:

$$\pi' = \beta' X = \beta_0 + \beta_1 X_{i1} + \beta_{p-1} X_{i,p-1} \quad (5)$$

RESULTS

Descriptive Statistics

The descriptive information of the independent variables has been obtained from the frequency runs as presented in Table 1. A total of 20,095 of respondents from the Fourth National Health and Morbidity Survey (NHMS IV) has been used in this study. Sample demographic factors consist of gender, age, race, education level, occupation, household income, residential area, and marital status. There are more females than males, 51.5% of females respondents and 48.5% are males respondents respectively. Majority of the respondents have secondary education (30.1%) but only 5.3% of the respondents have no formal education. About 34.4% of the respondents work in private sector. However, more than 30% of the respondents are reported to have low income level (RM0 to RM1,500). Only 9.1% of the respondents earn within the range RM5,001 to RM7,000. Overall, majority of the sample are Malays (58.7%), followed by Chinese (17.9%), other Bumiputra (9.8%), Indians (7.7%) and 5.9% for other races. Most of the respondents are in the age group 15 and 24 years (20.1%), married (51.5%) and urban residents (58.2%).

Table 1a: Descriptive Analyses of Demographic and Socioeconomic Characteristics of Respondents

Variable(s)	Level(s)	Frequency (n)	Percent (%)
Gender	Male	9751	48.5
	Female	10344	51.5
Education level	Unclassified	1253	6.2
	No formal education	1065	5.3
	Primary education	6055	30.1
	Secondary education	8166	40.6
	Tertiary education	3556	17.7
Occupation	Retiree	2378	11.8
	Home maker	4002	19.9
	Self-employed	4201	20.9
	Private	6922	34.4
	Government/Semi Government	2592	12.9
Household income	Above RM7,000	2181	10.9
	RM5,001-7,000	1828	9.1
	RM3,001-5,000	4174	20.8
	RM1,501-3,000	5512	27.4
	RM0-1,500	6400	31.8
Residential area	Urban	11688	58.2
	Rural	8407	41.8
Race	Others	1190	5.9
	Other Bumiputra	1978	9.8
	Indian	1541	7.7
	Chinese	3595	17.9
	Malays	11791	58.7

Table 1b: Descriptive Analyses of Demographic and Socioeconomic Characteristics of Respondents

Variable(s)	Level(s)	Frequency (n)	Percent (%)
Marital Status	Widow/widower or Divorced	965	4.8
	Married	10358	51.5
	Single	8756	43.6
Age	>65 years old	1047	5.2
	55-64 years old	1633	8.1
	45-54 years old	2745	13.7
	35-44 years old	3294	16.4
	25-34 years old	3830	19.1
	15-24 years old	4040	20.1
	<15 years old	3506	17.4

Diagnostic Tests for Binomial Logistic Model

Diagnostic tests have been conducted using the binomial logistic regression model to identify how the variables best fit under the influence of the dependent variables. Hosmer and Lemeshow goodness of fit test has shown that this model is a good fit to the data because the significance value is more than 0.05 (Table 2).

Table 2: Hosmer and Lemeshow Test

Chi-square	df	Sig.
21.680	8	.006

The values of Pseudo R^2 (Cox and Snell =0.107, Nagelkerke = 0.160) demonstrated that 10.7% and 16% of the variability can be explained by this set of variables which shows the model has been built "moderately" fits the data of this study.

Table 3: Pseudo R-Square (newly diagnosed hypertension)

Cox and Snell	0.107
Nagelkerke	0.160

Since the Variance Inflation Factor is less than 10, no collinearity exists among the independent variables in the binomial logistic regression model as depicted in Table 4. Hence, it is appropriate to proceed with all the independent variables to fit the binomial logistic regression model.

Table 4: Results of Multicollinearity Test for all Independent Variables

Factor	Tolerance	VIF
Age	0.419	2.386
Marital status	0.420	2.381
Gender	0.913	1.095
Physical Activity	0.975	1.026
Residential area	0.948	1.055
Race	0.924	1.082
Occupation	0.835	1.197
Household income	0.893	1.119
Fruit and vegetables consumption	0.993	1.007
Drinking Status	0.927	1.078
Smoking Status	0.989	1.012
Education level	0.816	1.226
Body Mass Index (BMI)	0.957	1.045

Table 5 classification table shows that of the cases to create the model, 14,615 of the 15,238 respondents have been classified correctly as healthy (No newly diagnosed hypertension) people. Likewise, 874 of the 4,834 of those who suffer from newly diagnosed hypertension have also been classified correctly. In total, 77.1% of the cases are classified correctly.

Table 5: Classification Table

Observed	Predicted		
	No newly diagnosed hypertension	**newly diagnosed hypertension**	**Percent Correct**
No hypertension	14615	623	95.9%
newly diagnosed hypertension	3960	874	18.1%
Overall Percentage			77.1%

Reporting results of newly diagnosed hypertension

The results from the estimated binomial logistic regression are reported in Table 6. The regression compares respondents who have newly diagnosed hypertension to those have no newly diagnosed hypertension. Physical inactivity has been found to significantly ($p<0.001$) influence the chance of having newly diagnosed hypertension. Respondents who are physically inactive are 0.865 times more likely to get newly diagnosed hypertension as to physically active respondents. Not all drinking status influences the chance of getting newly diagnosed hypertension. Only current drinkers have shown significantly ($p<0.001$) higher odds (OR=1.269) of having newly diagnosed hypertension in comparison to non-drinkers. Body Mass Index (BMI) has also been found as a significant ($p<0.001$) variable affecting the likelihood of having newly diagnosed hypertension. The odds of having newly diagnosed hypertension for obese and overweight respondents are (OR=2.490) and (OR=1.698) respectively in comparison to normal weight respondents.

The females have been found to have significantly ($p<0.001$) lower likelihood (OR=0.862, CI=0.797-0.932) of newly diagnosed hypertension than the

males. In the case of race, the odds ratio for Chinese and Indians are found to be less than one (OR=0.829 and 0.819 respectively), suggesting that Chinese and Indian respondents are less likely to have newly diagnosed hypertension in comparison to Malay respondents. However, other Bumiputra have significantly higher likelihood (OR=1.129, CI=1.000-1.275) of having newly diagnosed hypertension in comparison to Malays. Age also significantly ($p<0.001$) influences the likelihood of having newly diagnosed hypertension. The odds ratio in favor of having newly diagnosed hypertension for respondents of aged >65, 55-64, 45-54 and 35-44 years are 8.054, 5.620, 3.419 and 2.254 respectively. However, respondents aged between 15-24 years possess odds of having newly diagnosed hypertension that is significantly ($p<0.001$) less than one (OR=0.746), suggesting that those at lower age group are less likely to have newly diagnosed hypertension.

Similarly, education level acts as a significant ($p<0.001$) variable affecting the likelihood of newly diagnosed hypertension. The odds ratio for the respondents with no formal education, primary education and secondary education is more than one (1.367, 1.436 and 1.274 respectively), indicating that those with less education are also more likely to have newly diagnosed hypertension. It has been found that the odds of newly diagnosed hypertension have significantly ($p<0.001$) decreased among the urban residents (OR=0.920, CI=0.854-0.990) in comparison to the rural dwellers. Results also indicate that household income significantly ($p<0.05$) influences the likelihood of having newly diagnosed hypertension. The odd ratios for the respondents with household income above RM7,000 is OR=0.800, suggesting that those with higher income level are less likely to be newly diagnosed hypertensive. Married couples on the other hand, have significantly ($p<0.001$) decreased odds (OR=0.788, CI=0.690-0.899) of newly diagnosed hypertension in comparison to the single respondents. Conversely, all smoking status, inadequate fruit and vegetables consumption, ex-drinkers, unclassified drinkers, other ethnic respondents with unclassified education, self-employed, private sector respondents, all household income earners except above RM7000 have been found not associated with the likelihood of having newly diagnosed hypertension.

DISSCUSSION

With regard to physical activity, physically inactive respondents are found less likely to have newly diagnosed hypertension in this study. This is inconsistent with a previous research which revealed that physical inactivity was found to be significantly associated with increased odds of newly diagnosed hypertension among the urban Chinese adults[7]. It may be due to the fact that this current research and the previous study has been carried out at different contexts. There are some other factors such as excessive alcohol consumption which may contribute to the higher odds of newly diagnosed hypertension. The findings of this study exhibit that only the current drinkers have significantly higher odds of newly diagnosed hypertension and this is in agreement with a previous research based on China which revealed that alcohol drinking was significantly associated with increased odds of newly diagnosed hypertension[7]. Hence, it is essential that the government to conduct health awareness campaigns among Malaysians to prevent and monitor the prevalence of newly diagnosed hypertension. There is a significant difference between the obese as well as the overweight respondents and the likelihood of newly diagnosed hypertension in this study, which lends support to the previous research that mentioned the increasing weight would lead to increased prevalence of newly diagnosed hypertension[6]. Therefore, it can be concluded that excess body weight can act as a barrier towards prevention of newly diagnosed hypertension among Malaysians.

Next, the findings suggest that the female respondents have statistically significant lower likelihood of newly diagnosed hypertension. This is consistent with the arguments which stated that the females have slightly higher (39.3%) prevalence of newly diagnosed hypertension than the males (36.7%)[15]. However, the male respondents (Chinese urban adults) in China were found to be related to increased odds of newly diagnosed hypertension[7]. Similarly, another study suggested that the Maltee males tend to be more likely (64.01% CI 95%: 58.56–69.13) to have newly diagnosed hypertension[15].The results of this study shows that other Bumiputra are more likely to have newly diagnosed hypertension. On the other hand, both Indians and Chinese exhibits lower odds of having newly diagnosed hypertension. These findings have given a green light to the policy makers to address certain ethnic groups during the execution of health promotion programmes recommended by the Government.

Table 6: Results of Binomial Logistic Regression on Newly Diagnosed Hypertension

Hypertension Status	Variables	Estimated Coefficient	Standard Error	Wald	P-Value	Odds Ratio	95% C.I.for EXP (B)	
							Lower	Upper
newly diagnosed hypertension	**Age**							
	below 15 yrs old (R)	-	-	693.895	-	-	-	-
	>65 years old	2.086	.115	329.670	.000	8.054	6.430	10.088
	55-64 years old	1.726	.099	303.524	.000	5.620	4.628	6.825
	45-54 years old	1.229	.096	163.911	.000	3.419	2.832	4.127
	35-44 years old	.813	.097	70.419	.133	2.254	1.864	2.725
	25-34 years old	.137	.091	2.262	.000	1.147	.959	1.373
	15-24 years old	-.293	.079	13.836	.000	.746	.639	.870
	Marital Status							
	Single (R)	-	-	15.729	.000	-	-	-
	Widow/widower/divorced	-.084	.102	.671	.413	.920	.753	1.123
	Married	-.239	.067	12.519	.000	.788	.690	.899
	Gender							
	Male (R)							
	Female	-.149	.040	13.901	.000	.862	.797	.932
	Physical Activity							
	Active (R)							
	Inactive	-.145	.038	14.272	.000	.865	.803	.933

Table 6: continued

Hypertension Status	Variables	Estimated Coefficient	Standard Error	Wald	P-Value	Exp(B) Odds Ratio	95% C.I.for EXP (B)	
							Lower	Upper
newly diagnosed hypertension	**Residence**							
	Urban (R) Rural	-.084	.038	4.913	.027	.920	.854	.990
	Race							
	Malays (R)	-	-	25.660	.000	-	-	-
	Others	-.034	.082	.167	.683	.967	.823	1.137
	Other Bumiputra	.121	.062	3.824	.051	1.129	1.000	1.275
	Indian	-.199	.070	7.991	.005	.819	.714	.941
	Chinese	-.187	.053	12.387	.000	.829	.747	.920
	Occupation							
	Gov/Semi Gov (R)	-	-	7.143	.129	-	-	-
	Retire	.177	.078	5.058	.025	1.193	1.023	1.391
	Home maker	.146	.069	4.480	.034	1.157	1.011	1.324
	Self-employed	.068	.067	1.054	.305	1.071	.940	1.220
	Private	.069	.063	1.202	.273	1.072	.947	1.213
	Household income							
	RM0-1500 (R)	-	-	13.769	.008	-	-	-
	Above RM7000	-.223	.069	10.357	.001	.800	.698	.916
	RM5001-7000	-.123	.071	3.041	081	.884	.770	1.015
	RM3001-5000	-.051	.051	.984	.321	.950	.859	1.051
	RM1501-3000	.006	.046	.020	.889	1.006	.920	1.101

Table 6: continued

Hypertension Status	Variables	Estimated Coefficient	Standard Error	Wald	P-Value	Exp(B) Odds Ratio	95% C.I.for EXP (B)	
							Lower	Upper
newly diagnosed hypertension	**Fruit & Vegetables consumption**							
	Adequate (R)	-	-	-	.770	1.020	.892	1.167
	Inadequate	.020	.068	.086				
	Drinking status							
	Non-Drinker (R)	-	-	14.383	.002	-	-	-
	Unclassified	.159	.210	.567	.451	1.172	.776	1.770
	Current drinker	.238	.068	12.274	.000	1.269	1.111	1.449
	Ex-drinker	-.062	.087	.509	.476	.940	.793	1.114
	Smoking Status							
	Non-smoker (R)	-	-	2.978	.226	-	-	-
	Current smoker	-.024	.048	.263	.608	.976	.889	1.071
	Ex-smoker	.105	.087	1.460	.227	1.111	.937	1.317
	Education level	-	-	31.056	.000	-	-	-
	Tertiary (R)	.163	.104	2.459	.117	1.177	.960	1.443
	Unclassified	.313	.096	10.538	.001	1.367	1.132	1.651
	No formal	.362	.070	27.000	.000	1.436	1.253	1.646
	Primary	.242	.059	16.756	.000	1.274	1.135	1.431
	Secondary							
	Body Mass Index (BMI)							
	Normal weight (R)	-	-	421.551	.000	-	-	-
	Obese	.912	.049	346.780	.000	2.490	2.262	2.741
	Overweight	.529	.043	153.286	.000	1.698	1.561	1.846
	Underweight	-.163	.077	4.430	.035	.850	.731	.989

With respect to the age group, this study demonstrates that higher aged group respondents are more likely to have newly diagnosed hypertension. This is consistent with a previous research which reported that the highest prevalence was found in participants above the age 65 years. Therefore, it has been established that there was significant association between undiagnosed hypertension and increasing age ($p < 0.05$)[15]. This results also tallied with the findings of another study based on China, which stated that the older age was found to be associated with higher odds of newly diagnosed hypertension[7]. Similarly, the results of this study which demonstrates that lower education level has significantly higher odds of newly diagnosed hypertension tallies with another study which reported that lower educational status, illiteracy leads to higher prevalence (34.9%) of newly diagnosed hypertension[12].

Moreover, this study has revealed that the likelihood of newly diagnosed hypertension decreased among the urban residents (odds ratio, OR=0.924) in comparison to other rural dwellers. Consequently, this research shows that the rural respondents are more likely to have newly diagnosed hypertension. This finding is in alignment with a previous study which demonstrated that newly diagnosed hypertension rate was significantly higher in rural areas than in urban areas[8]. The possible reason behind this may be the fact that the rural population was older which consequently led to higher likelihood of newly diagnosed hypertension[16]. Interventions targeting the rural adults should promote the awareness of hypertension among Malaysians. The policy makers could use these findings to implement policy in rural area of in Malaysia to create more awareness among rural dwellers for the prevention of newly diagnosed hypertension.

Additionally, the findings of this study also demonstrate that the highest income group has significantly lower odds of newly diagnosed hypertension. This observation lends support to the research which reported that respondents with higher income had lower odds[7]. It is suggested that higher income group respondents would have better opportunity and will be able to afford medical facilities such as health screening to monitor blood pressure to prevent the likelihood of having newly diagnosed hypertension. Meanwhile, only highest income earners can afford the medical facilities in Malaysia due to the high cost in medical services especially in the private sector. On the contrary, the results of this study is not in alignment with a previous research which reported that having various sources of income would positively predicted the likelihood of hypertension[17]. Likewise, the results of this study indicate that the married couples will tend to have statistically lower odds of newly diagnosed hypertension in comparison to the single respondents. This is consistent with a previous research which reported that the married adults were less likely to have high blood pressure objectively in United States of America, but not in Ireland[18]. Additionally, it was found that the married individuals have potentially greater financial resources available for health care which prompts them to choose a healthier lifestyle[19].

A number of limitations have been identified in this study. To begin with, using secondary data has been very much complicated–because it is necessary to find out about the details of the secondary data. Nevertheless, it was tackled to a satisfactory level to give better understanding of the survey based on a few available materials, information gathered during the actual data management and published articles of the researchers involved in data collection. Secondly, this study is limited by its cross-sectional nature; therefore, cross-sectional design does not allow us to make any conclusive statement about the temporality of the observed associations.

CONCLUSIONS

This study provides not only a platform to predict the risk factors of newly diagnosed hypertension but also a means to deliver evidence and guidance to monitor as well as prevent newly diagnosed hypertension in Malaysia through the implementation of appropriate strategies. In conclusion, the findings have important implications on policy implementation by relevant authorities. It is evident that Malaysia is going to face the challenge of aging society. Not only that, based on the findings of the present study, it has been found that obese and overweight respondents, current drinkers, elderly, retirees and home makers, as well as lower educated respondents are respectively more likely to have newly diagnosed hypertension. The occurrence of newly diagnosed hypertension will definitely create deadweight loss and reduced welfare, utility and quality of life among the stated groups especially elderly, retirees and home makers. This would eventually increase the burden on healthcare cost of the country in the future. Hence, these findings will serve as a good benchmark for the Government to allocate resources more efficiently during budgeting.

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COMPETING INTERESTS

The authors declare that they have no competing interests.

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