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**Original Article**

# The Determinants of Undiagnosed Hypertension among Urban Community of Kuala Lumpur, Malaysia

***Ariff Azfarahim Ibrahim, *Mohd Rizal Abdul Manaf, Noor Hassim Ismail***

*Department of Community Health, Faculty of Medicine, Universiti Kebangsaan Malaysia Medical Centre, Jalan Yaacob Latiff, Kuala Lumpur, Malaysia*

***Corresponding Author:** Email: mrizal@ppukm.ukm.edu.my

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**Abstract**

**Background:** The prevalence of undiagnosed hypertension in Malaysia is 17.2%, which is higher compared to the known case of hypertension (13.1%) reported in 2015. For every two people diagnosed with hypertension, there will be three persons with undiagnosed hypertension; the trend has not changed since 2011. This study aimed to determine the determinants of undiagnosed hypertension among urban community of Kuala Lumpur, Malaysia.

**Methods:** This was a cross-sectional study conducted among 206 participants in Kuala Lumpur, Malaysia from the ongoing Prospective Urban Rural Epidemiology (PURE) project. The samples with complete variable data were taken from the second year of follow-up, starting Jan 2014 till Dec 2015, through convenience sampling. Data were analyzed using descriptive analysis, simple logistic regression, and multivariable logistic regression.

**Results:** Multivariable logistic regression showed that only four determinants were associated with undiagnosed hypertension which were the age group of 35 to 49 yr old (aOR: 5.9, 95% CI: 1.8; 19.1), secondary education level (aOR: 2.3, 95% CI: 1.1; 4.6), normal BMI (aOR: 5.1, 95% CI: 1.5; 16.6), and non-diabetes mellitus (aOR: 5.5, 95% CI: 2.5; 12.0).

**Conclusion:** The determinants of undiagnosed hypertension in this study showed that low-risk groups of hypertension were highly underdiagnosed. The low-risk group of hypertension was easily approached at their working place. Thus, routine health screening and awareness campaigns should be emphasized substantially at the working place to detect undiagnosed hypertension. Early detection will be beneficial as early management can be initiated to prevent further complications.

**Keywords:** Undiagnosed hypertension; Age; Educational level; Diabetes mellitus

## Introduction

Noncommunicable diseases (NCD) have been a double burden of diseases all around the world. Hypertension is one of the famous NCDs that lead to the risk factor of cardiovascular diseases and stroke (1, 2). It is often asymptomatic and known as a 'silent killer' (3). The WHO estimates that about one billion people aged 25 yr and above are currently suffering from hypertension (4). The severity of hypertension significantly contributes to mortality and morbidity, by affecting nearly one out of three adults or about 75 million people in the United States (US) according to the 2017 American College of Cardiology/American Heart Association (ACC/AHA) Hypertension Guideline (1). In the Asian region, hypertension is affecting more than 35% of the adult population (5). Specifically, in Malaysia, hypertension is the main risk factor of premature death as it can lead to ischemic heart disease, cardiovascular diseases, and stroke. The prevalence of hypertension in Malaysia is at an alarming stage. More than one-third of Malaysians aged 18 yr and above suffer from this condition and the number increased from 33.6% in 2011 to 35.3% in 2015 (6).

The stable increase in prevalence is due to improved screening and diagnosis as medical services improve in the country (7). Early detection of hypertension can reduce its complications, hence, reducing the disease burden socially and economically. There is bulk evidence showing that treating hypertension reduces the disease burden it causes. However, in US, eleven million US adults with hypertension are not aware that they have the problem (1). The prevalence of undiagnosed hypertension has been found to range between 17%–60% (5,8-10). The National Health and Morbidity Survey (NHMS) of Malaysia in 2015 showed that for every two diagnosed hypertension patients in Malaysia, there were three undiagnosed hypertension patients. The actual prevalence of hypertension is higher than the current figures. Regardless, hypertension is preventable and treatable. The early detection of at-risk populations is the cornerstone of an effective management. The improvement can be done if all high-risk populations of hypertension are promptly identified, accurately diagnosed, and provided with evidence-based treatment and support (11).

Thus, we aimed to identify the determinants of undiagnosed hypertension among urban community of Kuala Lumpur, Malaysia. This study will provide an analysis for future planning of early screening and detection of hypertension among the high-risk groups.

## Materials and Methods

### *Research design and population*

This study was based on the data of the ongoing Prospective Urban Rural Epidemiology (PURE) project in Malaysia. The details of the cohort investigation have been previously published (12). The study location of PURE consisted of rural and urban areas in the two states of Kuala Lumpur and Selangor. All secondary data were obtained from the second year of PURE follow-up survey starting from Jan 2014 till Dec 2015 in two urban areas of Kuala Lumpur, which consisted of 1000 participants. However, those participants with completed data were only taken into analysis. This study used convenience sampling. Thus, the current analysis was a cross-sectional study conducted among 206 adult participants aged between 35 to 75 yr old.

### *Data collection*

This study was based on two questionnaires. First, data were gathered using adult questionnaires that contained the participant's status of hypertension, diabetes mellitus, smoking habit, resting blood pressure, and anthropometric measurements (weight, height, and waist circumference). Meanwhile, the Family Census Questionnaire recorded the demographic information, education background, and marital status of participants.

### *Data measurement*

Blood pressure was measured during household visits. The blood pressure measurements were taken two times in the sitting position with an interval of 5 min using Omron Digital Automatic Blood Pressure Monitor Model HEM-907, previously validated and calibrated. A systolic blood pressure of ≥140 mmHg and/or diastolic blood pressure of ≥90 mmHg was considered as the cut-off level to determine the presence of hypertension. Known hypertension was considered to have been diagnosed when the participants were declared as having hypertension and taking antihypertensive medications. Those declaring to not have hypertension but were found to have elevated blood pressure on examination were classified as having undiagnosed hypertension. The blood pressure measurement was further classified based on Malaysian Clinical Practice Guidelines as in T 1 for descriptive analysis to determine the severity of hypertension among the study population (13).

**Table 1:** Classification of blood pressure level

| *Classification* | *Systolic (mmHg)* | | *Diastolic (mmHg)* |
|---|---|---|---|
| Normal | ≤139 | and/or | ≤89 |
| Hypertension | | | |
| Stage 1 (Mild) | 140 – 159 | and/or | 90 – 99 |
| Stage 2 (Moderate) | 160 – 179 | and/or | 100 – 109 |
| Stage 3 (Severe) | ≥180 | and/or | ≥110 |

Anthropometric measurement for height was done using SECA Stadiometer 213. When measuring the height, the respondents were to stand upright and barefooted on a flat surface with the back of the heels and occiput against the equipment. The height was measured and rounded to the nearest 0.1 cm. Respondents were weighed with light clothing without any footwear. An electronic scale (Seca Gmbh, Hamburg, Germany) was used to measure the weight. The weight was measured and rounded to the nearest 0.1 kg. The body mass index (BMI) was calculated as weight (kg)/height$^2$ (m$^2$). BMI was categorized using the BMI cutoff values for Malaysians. The BMI categories were normal (BMI 18.5–22.9 kg/m$^2$), overweight (23–27.4 kg/m$^2$), and obese (≥27.5 kg/m$^2$) (14). For measuring waist circumference, the midpoint between the lower margin of the last rib and the top of the hip bone was first identified and the respondents were advised to hold their breath at the end of expiration. Then, an inelastic measuring tape was put at the umbilicus level. It was measured and rounded to the nearest 0.1 cm. The cut-off point according to Malaysia Clinical Practice Guidelines on Management of Obesity 2004 is 90 cm for men and 80 cm for women.

### *Statistical analysis*

All data were analyzed using IBM SPSS version 21 (IBM Corp., Armonk, NY, USA). The descriptive statistics were represented as frequencies and percentages for the categorical variables. The association for each variable was analyzed using simple logistic regression (SLR) in bivariate analysis. Multivariable logistic regression was used to estimate the adjusted odds ratio (aOR) and 95% confidence interval of determinants of undiagnosed hypertension. The level of significance was set at a *P*-value of <0.05.

### *Ethical approval*

This study was approved by the Medical Research Ethics Committee of Universiti Kebangsaan Malaysia (PHUM-2012-01). Informed consent was obtained from the participants prior to data collection. A research information sheet was given to each of the participants. The participants were also briefed regarding the research information on the day of data collection. Respondents were ensured of the confidentiality of their data and they had the right to withdraw from the study at any time.

## Results

Table 2 shows a sociodemographic data of the study population. However, out of 1000 participants, there were around 70% of participants only that available for sociodemographic data. More than half were aged 50 to 64 yr old (51.1%) and female (56.7%). The majority of them were married (84.4%) and 60% of them had a secondary level of educational background.

**Table 2:** Sociodemographic data of study population

| *Characteristics* | *Frequency (%) (N = 698)* |
|---|---|
| Age, year | |
| 35 – 49 | 228 (32.7) |
| 50 – 64 | 357 (51.1) |
| ≥ 65 | 113 (16.2) |
| Gender | |
| Male | 302 (43.3) |
| Female | 396 (56.7) |
| Marital Status | |
| Married | 589 (84.4) |
| Single | 109 (15.6) |
| Educational Level | |
| Primary level | 279 (40.0) |
| Secondary level | 419 (60.0) |

Further screening on the secondary data showed only 206 hypertensive participants had completed data that were available for statistical analysis as shown in Table 3. It was found out 39.8% of the samples classified as undiagnosed hypertension. While Table 4 shows the distribution of blood pressure measurement which classified according to the severity as stated in Malaysian Clinical Practice Guidelines between the group of undiagnosed hypertension and known hypertension. Most of participants with undiagnosed hypertension were in Stage 1 with 73.2%. There were only 19.5% in Stage 2 and 7.3% in Stage 3. On the other hand, known hypertension were divided into four classifications. There were 36.3% of them with controlled blood pressure. The rest were 44.4% in Stage 1, 15.3% in Stage 2 and 4.0% in Stage 3.

**Table 3:** Descriptive analysis of study population with all variables data

| *Characteristics* | *Frequency (%) (N = 206)* |
|---|---|
| Age, year | |
| 35 – 49 | 35 (17.0) |
| 50 – 64 | 125 (60.7) |
| ≥ 65 | 46 (22.3) |
| Gender | |
| Male | 59 (28.6) |
| Female | 147 (71.4) |
| Marital Status | |
| Married | 181 (87.9) |
| Single | 25 (12.1) |
| Educational Level | |
| Primary level | 91 (44.2) |
| Secondary level | 115 (55.8) |
| Smoking Status | |
| Smoker | 14 (6.8) |
| Non-smoker | 192 (93.2) |
| BMI | |
| Normal | 34 (16.5) |
| Overweight | 61 (29.6) |
| Obese | 111 (53.9) |
| Waist circumference | |
| Below cut-off point | 31 (15.0) |
| Cut-off point and above | 175 (85.0) |
| Diabetes Mellitus | |
| Yes | 71 (34.5) |
| No | 135 (65.5) |
| | |
| Known Hypertension | 124 (60.2) |
| Undiagnosed Hypertension | 82 (39.8) |

**Table 4:** Descriptive analysis of undiagnosed hypertension and treated hypertension

| *Classification* | *Undiagnosed Hypertension N=82 (39.8%)* | *Known Hypertension N=124 (60.2%)* |
|---|---|---|
| Normal | - | 45 (36.3) |
| Stage 1 (Mild) | 60 (73.2) | 55 (44.4) |
| Stage 2 (Moderate) | 16 (19.5) | 19 (15.3) |
| Stage 3 (Severe) | 6 (7.3) | 5 (4.0) |

Bivariate analysis was further performed to show the associated factors of undiagnosed hypertension. The results are subsequently shown in Table 5. The age group 35 to 49 yr old was statistically significant and associated with undiagnosed hypertension (*P*=0.001), normal BMI (*P*=0.002), waist circumference below the cut-off point (*P*=0.003), and secondary education level (*P*=0.001). Non-diabetes mellitus participants also showed significant association with undiagnosed hypertension (*P*<0.001). Meanwhile, other variables such as gender, marital status, and smoking were not associated significantly.

**Table 5:** Bivariate analysis between treated hypertension and undiagnosed hypertension

| ***Factors*** | ***Undiagnosed hypertension N= 82 (39.8%)*** | ***Known hypertension N= 124 (60.2%)*** | ***Simple Logistic Regression*** | | | |
|---|---|---|---|---|---|---|
| | | | Wald | *P*-value | Crude OR | 95% CI |
| Age, year | | | | | | |
| 35 – 49 | 23 (28.0) | 12 (9.7) | 10.70 | 0.001* | 4.9 | (1.9;12.6) |
| 50 – 64 | 46 (56.0) | 79 (63.7) | 1.08 | 0.30 | 1.5 | (0.7; 3.1) |
| ≥ 65 | 13 (16.0) | 33 (26.6) | | | 1.0 | |
| Gender | | | | | | |
| Male | 27 (32.9) | 32 (25.8) | 1.22 | 0.27 | 1.4 | (0.8; 2.6) |
| Female | 55 (67.1) | 92 (74.2) | | | 1.0 | |
| Marital Status | | | | | | |
| Single | 10 (12.2) | 15 (12.1) | 0.000 | 0.98 | 1.0 | (0.4; 2.4) |
| Married | 72 (87.8) | 109 (87.9) | | | 1.0 | |
| Educational Level | | | | | | |
| Primary | 25 (30.5) | 66 (53.2) | | | 1.0 | |
| Secondary | 57 (69.5) | 58 (46.8) | 10.11 | 0.001* | 2.6 | (1.4; 4.7) |
| Smoking Status | | | | | | |
| Smoker | 7 (8.5) | 7 (5.6) | | | 1.0 | |
| Non-smoker | 75 (91.5) | 117 (94.4) | 0.64 | 0.42 | 1.0 | (0.2; 1.9) |
| BMI | | | | | | |
| Normal | 22 (26.8) | 12 (9.7) | 9.97 | 0.002* | 3.7 | (1.6; 8.2) |
| Overweight | 23 (28.1) | 38 (30.6) | 0.33 | 0.57 | 1.2 | (0.6; 2.3) |
| Obese | 37 (45.1) | 74 (59.7) | | | 1.0 | |
| Waist circumference | | | | | | |
| Below cut-off point | 20 (24.4) | 11 (8.9) | 8.65 | 0.003* | 3.3 | (1.5; 7.4) |
| Cut-off point and above | 62 (75.6) | 113 (91.1) | | | 1.0 | |
| Diabetes Mellitus | | | | | | |
| No | 71 (86.6) | 64 (51.6) | 23.61 | <0.001* | 6.1 | (2.9; 12.5) |
| Yes | 11 (13.4) | 60 (48.4) | | | 1.0 | |

**P*<0.05

Multivariable analysis (multivariable logistic regression) was conducted on significant variables found in bivariate analysis. Table 6 shows the adjusted odds ratio (aOR) of the determinants for undiagnosed hypertension.

**Table 6:** Multivariable logistic regression of the determinants of undiagnosed hypertension

| ***Factors*** | ***Multivariable logistic regression*** | | | |
|---|---|---|---|---|
| | Wald | *P*-value | Adjusted OR | 95% CI |
| Age, year | | | | |
| 35 – 49 | 8.93 | 0.003* | 5.9 | (1.8; 19.1) |
| 50 – 64 | 2.49 | 0.12 | 2.0 | (0.8; 4.8) |
| ≥ 65 | | | 1.0 | |
| Educational Level | | | | |
| Primary | | | 1.0 | |
| Secondary | 5.13 | 0.02* | 2.3 | (1.1; 4.6) |
| BMI | | | | |
| Normal | 7.16 | 0.007* | 5.1 | (1.5; 16.6) |
| Overweight | 1.25 | 0.26 | 1.6 | (0.7; 3.4) |
| Obese | | | 1.0 | |
| Waist circumference | | | | |
| Below cut-off point | 0.38 | 0.54 | 1.4 | (0.5; 4.5) |
| Cut-off point and above | | | 1.0 | |
| Diabetes Mellitus | | | | |
| No | 18.16 | <0.001* | 5.5 | (2.5; 12.0) |
| Yes | | | 1.0 | |

*$P<0.05$

## Discussion

There is a minimal number of studies that have looked specifically into the determinants of undiagnosed hypertension in Malaysia. Thus, the findings of this study may give beneficial input for policymakers in sorting the priorities of screening programs. This study revealed four determinants of undiagnosed hypertension, which were the age group 35 to 49 yr old, secondary education level, normal BMI, and non-diabetes mellitus individuals. However, waist circumference was also a significantly associated factor in bivariate analysis.

Younger age is significantly associated with undiagnosed hypertension (9,15). The age group 35 to 49 yr old had almost six times higher the odds of being undiagnosed with hypertension compared to an older age group. Similar findings were found in Indian and Lebanese populations (3,4). Furthermore, higher frequency of health care visits among the elderly increases the probability of diagnosing hypertension. Young-aged adults seldom come to nearby health clinics for health screening as simple as blood pressure screening. They are less often suspected or screened, resulting in their diagnosis of undiagnosed hypertension. Besides, most of them are asymptomatic and tend to focus on work rather than visiting the health clinic.

Even though several studies have shown that lower education level is significantly associated with undiagnosed hypertension (4,5), our finding has revealed the opposite. The secondary education level was 2.3 times higher according to the odds of being undiagnosed hypertension. This is probably due to the samples having been obtained from an urban population, whereby everyone has an equal chance and access to healthcare facilities. The assumption is that those with secondary education level has a better chance of getting good employment that leads to good quality of life compared to those with primary education level. Higher life satisfaction is associated with fewer doctor visits, whereby less frequent visits may result in a misdiagnosis of hypertension (16).

Anthropometric measurements such as BMI have been proven to be the best determinants in predicting hypertension, particularly in a large population and community-based studies (17,18). Participants with normal BMI had 5.1 times higher the odds of being undiagnosed compared to obese participants. In Bangladesh, a lower BMI was the determinant of undiagnosed hypertension (5). Normal weight group is relatively considered to be a group with low risk of hypertension, thus, becoming more likely to be neglected and undiagnosed. This result was supported by a study on awareness of hypertension among hypertensive subjects in Malaysia (7). Those with a lower BMI have the lowest awareness of hypertension compared to those with higher BMI, showing a reducing trend from 34.3% in 2011 to 32.3% in 2015.

Those who were non-diabetes mellitus patients posed 5.5 times higher odds to have undiagnosed hypertension. Such observation was noted because a patient with diabetes mellitus will be managed accordingly based on the guidelines, which have frequent and thorough health check-up at a health clinic, including blood pressure monitoring (19). There is a possibility for misdiagnosis of hypertension among patients without diabetes mellitus as they do not attend any medical screening at public or private health care facilities. Furthermore, most of them are asymptomatic. The finding is consistent with a study done in France, which shows that non-diabetes mellitus individuals are significantly associated with undiagnosed hypertension (8).

This study also had several limitations. Firstly, there is selection bias due to small sample size in the study. It was unavoidable as the rest of the participant data were not completed. Secondly, blood pressure measurement was taken during a single visit, which possibly resulted in the overestimation of undiagnosed hypertension. According to the Malaysian Clinical Practice Guidelines, hypertension is defined as the persistent elevation of systolic blood pressure of 140 mmHg or greater and/or diastolic blood pressure of 90 mmHg or greater, taken at least twice on two separate occasions (13).

## Conclusion

The determinants of undiagnosed hypertension in this study showed that low-risk groups of hypertension were highly underdiagnosed. The low-risk group of hypertension was easily approached at their working place. Thus, routine health screening and awareness campaigns should be emphasized substantially at the working place to detect undiagnosed hypertension. Early detection will be beneficial as early management can be initiated to prevent further complications.

## Journalism Ethics considerations

Ethical issues (Including plagiarism, informed consent, misconduct, data fabrication and/or falsification, double publication and/or submission, redundancy, etc.) have been completely observed by the authors.

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## Conflict of interest

The authors declare that there is no conflict of interests.

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