Malaysian Family Physician
Official Journal of the Academy of Family Physicians of Malaysia
and Family Medicine Specialist Association of Malaysia

ORIGINAL ARTICLE

Prevalence of undiagnosed depression among patients with hypertension: A cross-sectional study of Malaysian primary care perspective

Siaw Mei Choong, Ping Yein Lee, Aneesa Abdul Rashid

Choong SM, Lee PY, Rashid AA. Prevalence of undiagnosed depression among patients with hypertension: A cross-sectional study of Malaysian primary care perspective. *Malays Fam Physician.* 2023;18:10. https://doi.org/10.51866/oa.214

Keywords:
Hypertension, Primary care, Depression

Authors:

Siaw Mei Choong
(Corresponding author)
MD (UPM), MMed Family Medicine (UPM)
Klinik Kesihatan Pasir Panjang, Taman Pasir Panjang,Port Dickson, Negeri Sembilan, Malaysia.
Email: siawmei@hotmail.com

Aneesa Abdul Rashid
(Corresponding author)
MBBCh BAO (NUI) (IRL), DrFamMed (UKM)
Department of Family Medicine, Faculty of Medicine and Health Sciences, Universiti Putra Malaysia, Serdang, Selangor, Malaysia.
Email: aneesa@upm.edu.my

Ping Yein Lee
MBBS (UM), DrFamMed (UM)
E-Health Unit, Faculty of Medicine, University of Malaya, Kuala Lumpur, Malaysia.

Abstract

Introduction: This study aimed to determine the prevalence of suspected depression and its associated factors among patients with hypertension in a Malaysian primary care clinic.

Methods: This cross-sectional study was conducted in a primary care clinic from 1 June to 31 August 2019 using the Patient Health Questionnaire-9.

Results: The prevalence of suspected depression was 9.0%. The significant predictors of depression were Indian ethnicity (adjusted odd ratio [AOR]: 2.373; confidence interval [CI]: 1.147–4.907), divorce (AOR: 3.5; CI: 1.243–9.860), singleness (AOR: 2.241; CI: 1.182–4.251), heavy episodic drinking (AOR: 7.343; CI: 2.494–21.624), low physical activity level (AOR: 1.921; CI: 1.093–2.274), low fibre intake (AOR: 1.836; CI: 1.061–3.178), uncontrolled blood pressure (AOR: 1.800; CI: 1.134–2.858) and presence of hypertension complications (AOR: 3.263; CI: 2.053–5.185).

Conclusion: Primary health care providers must screen for depression among patients with hypertension, particularly those within high-risk groups, and implement interventions that address modifiable risk factors.

Introduction

The estimated global prevalence of hypertension among adults increased from 594 million in 1975 to 1.13 billion in 2015.[1] In Malaysia, hypertension is one of the commonest non-communicable diseases with an overall prevalence of 30.3% among adults; more than half of affected patients have sought treatment at government primary care clinics (58.3%).[2]

A national survey showed that only 35% of patients with hypertension in Malaysia achieved blood pressure (BP) control while on treatment compared with 51% and 80% of patients in England and Canada, respectively.[3] Poor medication adherence, lack of information about hypertension, side effects of medications and polypharmacy have been reported to be associated with uncontrolled hypertension.[4] Depression has been found to be a predictor of uncontrolled BP among patients with hypertension.[5] Uncontrolled hypertension is also shown to be closely related to depression, as co-existing depression in patients with hypertension affects medication compliance. In a previous study, 38.3% of patients with hypertension were found to be non-compliant to medical treatment.[6] The presence of both comorbidities increases the risk of a poor health condition, decreased life quality, cerebrovascular accident or myocardial infarction, reduced rate of treatment adherence, higher suicidal risk and higher mortality.[7,8]

Rabkin et al. reported that major depression was three times more frequently found in patients with hypertension.[9] A systematic review of 41 studies with a total population of 30,796 individuals summarised that the prevalence of depression among patients with hypertension was 26.8%, and of these patients, 26.3% sought treatment at community settings.[7] Studies conducted in developing countries such as urban Nepal, Saudi Arabia, Makkah and Pakistan found a wide range of prevalence of depression (15–66.7%) among patients with hypertension.[8,10-12] However, data on the prevalence of depression among these patients in Malaysia are limited.

The heterogeneity in the prevalence across available studies is attributed to the difference in the methods of evaluation and the sociodemographic profiles, health behaviours and clinical characteristics of patients.[7] Moreover, Malaysia has three main ethnic groups that differ in terms of cultural background and language. Language barrier

may occur between doctors and patients of different ethnicities. Hence, findings from other countries may not be applicable to Malaysia.

Owing to the aforementioned issues and gaps in the literature, this study aimed to determine the prevalence of suspected depression among patients with hypertension and its associated factors.

Methods

Study design and setting

This cross-sectional study was conducted in a primary care clinic from June to August 2019 in Seremban, Negeri Sembilan, Malaysia.

Study population

This consisted of patients from the aforementioned clinic. The inclusion criteria were age of ≥18 years and diagnosis of hypertension with a duration of at least 6 months. Hypertension was defined as a systolic BP of ≥140 mmHg or a diastolic BP of ≥90 mmHg as diagnosed by a health care provider. The exclusion criteria were underlying diabetes mellitus, ischaemic heart disease, stroke or malignancy; mental disorder; anti-depressant treatment; pregnancy; and illiteracy.

Sampling method and participant recruitment

Systematic random sampling was used. Participant selection started at the registration counter of the NCD clinic through an electronic registry as shown in the **figure 1** in supplementary material.

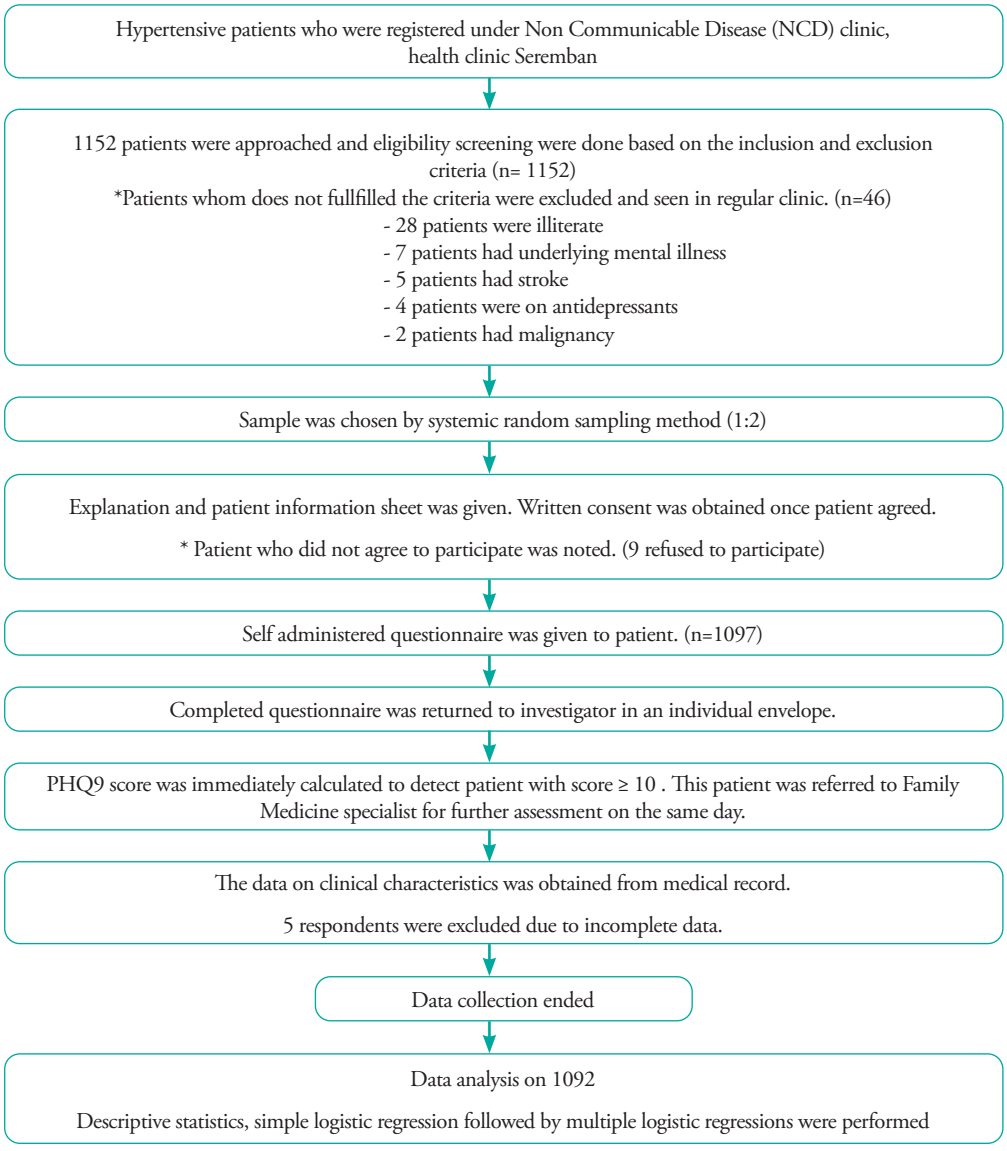

Figure 1. Flow chart of the study design and process.

Study tools

The study instruments were available in three different languages (Malay, Mandarin and English) and consisted of three parts: sociodemographic profiles and health behaviours, Patient Health Questionnaire-9 (PHQ-9) results and clinical characteristics. The PHQ-9 comprises nine questions scored from 0 to 3 points, yielding a total maximum score of 27 points. The participants were diagnosed with suspected depression when the total PHQ-9 score was ≥10 points. The sensitivity of the English, Malay and Chinese PHQ-9 versions was 88%, 86% and 87%, respectively; meanwhile, the specificity was 88%, 82% and 94%, respectively.[13-15] Conversely, information regarding hypertension was traced from the participants' medical records. Weight, height and body mass index (BMI) were measured.

Data collection and study procedures

The BP was measured twice with a 1 min interval on the left arm in a sitting position. The average value of the two readings were calculated and used for the analysis. BP control was determined on the basis of the average BP reading over the last three visits. Medical records were reviewed to ensure the accuracy and completeness of the information given.

The PHQ-9 on a score of ≥10 points were referred to family medicine specialists for further assessment on the same day. If appointments were full, they were given an appointment within a week, and the clinic's emergency contact number was provided. Subsequently, the patients were managed under multidisciplinary care in wellness clinics.

Sample size calculation

The sample size was calculated using a two-sample proportion formula: $N = [Z_{1-\alpha/2} ((\sqrt{2P(1 - P))} + Z_{1-\beta} (\sqrt{ (P_1(1 - P_1) + P_0 (1 - P_0))]^2 \times 2/ (P1-P0)^2$, with 5% precision and 80% power. The factor used was based on the percentage of depression among patients with hypertension with and without complications (P1: 71.4% vs P0: 62.5%) from the study by Al-Lugmani et al.[11] Finally, a total sample size of 1092 patients was calculated.

Statistical analysis

The data were statistically analysed using the IBM Statistical Package for the Social Sciences (SPSS) version 22. All statistical analyses were performed with the confidence interval set at 95% and the significance level at P<0.05. All descriptive data were reported as frequencies and percentages. According to the PHQ-9 score, the participants were categorised as either not depressed (total score of <10 points) or depressed (total score of ≥10 points). The χ^2 test was performed to determine the association of the depression status with the categorical independent variables. The factors associated with depression among the patients with hypertension were analysed using simple logistic regression (SLogR) followed by multiple logistic regression (MLogR). The independent variables with a P-value of <0.25 in the univariate analysis were included in the final multivariate analysis. Multivariate logistic regression was used to predict the risk of depression based on the associated factors. Odds ratios and 95% CIs were calculated with the significance level set at P<0.05.

Definition of terms

Heavy episodic drinking was defined as consumption of five standard drinks in men and four standard drinks in women at one time during the last 12 months.[16] It was measured by asking the respondents to report the quantity of spirits (single spirit shot), beer (pint/cans) and wine (small wine glass) they usually take at one time per occasion. These data were converted into standard drinks (one standard drink = half pint or one can of beer; 250 mL), single spirit shot (local spirit and hard liquor; 25 mL) and small glass of wine (105 mL). Physical activity was measured on the basis of self-reported frequency (day/week) and duration (minute/each section) of exercise performed. The total duration of exercise (minute) performed in a week was calculated. The physical activity duration was further categorised as <150 and ≥150 min/week. The respondents performing physical activity for <150 min/week were classified as having a low physical activity level.[16]

Results

Prevalence of depression among the patients with hypertension

A total of 1152 patients with hypertension aged ≥18 years were approached to participate in this study. Of them, 1092 agreed to enrol in the study, which yielded a response rate of 94.8%. The percentage of suspected depression among the participants was 9.0% (n=102).

Sample characteristics according to the depression status

Tables 1 and **2** illustrate the distribution of the sociodemographic profiles, health behaviours and clinical characteristics of the participants according to their depression status. The median

age was 63 years, and more than half of the participants (56.9%) were women. Most of them (32.3%) were housewives, and 74.3% had a monthly household income of <3000 RM. Approximately 88.9% of the participants were non-smokers. However, 16% consumed alcohol within the past 12 months, and 5.1% of them were classified as having 'heavy episodic drinking'.

Approximately 56.0% of the participants practiced regular physical activity, while 71.0% had a low physical activity level. Daily fruit or vegetable consumption and high fibre intake were noted in 86.8% and 68.2% of the participants, respectively. The median BMI was 25.9 (IQR: 5.6) kg/m^2, and 41.8% of the participants were overweight. The majority (43.6%) took one type of antihypertensive medication, and the median duration of hypertension was 8 (IQR: 10) years. The mean systolic BP was 136.1 mmHg (SD: ±12.3), while the median diastolic BP was 79 mmHg (IQR: 12). More than half of the participants (59.5%) had good BP control. Approximately 53.1% had three to six clinic visits per year, and 70.4% had a family history of hypertension.

Table 1. Sociodemographic characteristics of the respondents according to the depression status.

Variable	N=1092 (%)	Depression	No depression	χ^2 statistic (df)	P-value
		n=102 (%)	n=990 (%)		
Age				7.454 (3)	0.059
≤40 years	60 (4.5)	7 (14.0)	43 (86.0)		
41–50 years	109 (10.0)	17 (15.6)	92 (84.4)		
51–60 years	262 (24.0)	23 (8.8)	239 (91.2)		
>60 years	671 (61.4)	55 (8.2)	616 (91.8)		
Sex				0.000 (1)	0.999
Male	471 (43.1)	44 (9.3)	427 (90.7)		
Female	621 (56.9)	58 (9.3)	563 (90.7)		
Ethnicity				14.030 (3)	**0.003***
Malay	207 (19.0)	14 (6.8)	193 (93.2)		
Chinese	661 (60.5)	53 (8.0)	608 (92)		
Indian	210 (19.2)	32 (15.2)	178 (84.8)		
Others	14 (1.3)	3 (21.4)	11 (78.6)		
Marital status				17.510 (3)	**0.001***
Married	783 (71.7)	59 (7.5)	724 (92.5)		
Widow	170 (15.6)	17 (10)	153 (90)		
Divorced/separated	31 (2.8)	6 (19.4)	25 (80.6)		
Single	108 (9.9)	20 (18.5)	88 (81.5)		
Educational status				0.480 (3)	0.923
No formal education	53 (4.9)	5 (9.4)	48 (90.6)		
Primary education	361 (33.1)	36 (10.0)	325 (90.0)		
Secondary education	540 (49.5)	50 (9.3)	490 (90.7)		
Tertiary education	138 (12.6)	11 (8.0)	127 (92.0)		
Employment status				2.080 (3)	0.556
Retired	334 (30.6)	33 (9.9)	301 (90.1)		
Employed	340 (31.1)	26 (7.6)	314 (92.4)		
Unemployed	65 (6.0)	8 (12.3)	57 (87.7)		
Housewife	353 (32.3)	35 (9.9)	318 (90.1)		
Household income				1.100 (1)	0.578
<3000 RM	811 (74.3)	80 (9.9)	731 (90.1)		
3000–5999 RM	223 (20.4)	18 (8.1)	205 (91.9)		
≥6000 RM	58 (5.3)	4 (6.9)	54 (93.1)		

*P<0.05

Table 2. Health behaviours and clinical characteristics of the respondents according to the depression status.

Variable	N=1092 (%)	Depression	No depression	χ^2 statistic (df)	P-value
		n=102 (%)	n=990 (%)		
Smoking				0.320 (1)	0.574
Yes	121 (11.1)	13 (10.7)	108 (89.3)		
No	971 (88.9)	89 (9.2)	882 (90.8)		
Alcohol consumption				3.560 (1)	0.059
Yes	175 (16.0)	23 (13.1)	152 (86.9)		
No	917 (84.0)	79 (8.6)	838 (91.4)		
Heavy episodic drinking				30.790 (1)	**<0.001***
Yes	56 (5.1)	17 (30.4)	39 (69.6)		
No	1036 (94.9)	85 (8.2)	951 (91.8)		
PA				4.540 (1)	**0.033***
Yes	612 (56.0)	47 (7.7)	565 (92.3)		
No	480 (44.0)	55 (11.5)	425 (88.5)		
Duration of PA				7.080 (1)	**0.008***
<150 min/week	775 (71.0)	84 (10.8)	691 (89.2)		
≥150 min/week	317 (29.0)	18 (5.7)	299 (94.3)		
Daily fibre intake				20.000 (1)	**<0.001***
Yes	948 (86.8)	74 (7.8)	874 (92.2)		
No	144 (13.2)	28 (19.4)	116 (80.6)		
Amount of fibre intake				23.250 (1)	**<0.001***
<2 servings/day	347 (31.8)	54 (15.6)	293 (84.4)		
≥2 servings/day	745 (68.2)	48 (6.4)	697 (93.6)		
BMI				2.890 (3)	0.408
Underweight (<18.5 kg/m^2)	35 (3.2)	3 (8.6)	32 (91.4)		
Normal (18.5–22.9 kg/m^2)	219 (20.1)	20 (9.1)	199 (90.9)		
Overweight (23.0–27.4 kg/m^2)	457 (41.8)	36 (7.9)	421 (92.1)		
Obese (≥27.5 kg/m^2)	381 (34.9)	43 (11.3)	338 (88.7)		
No. of antihypertensive medication taken				0.938 (2)	0.625
1	476 (43.6)	48 (10.1)	428 (89.9)		
2	412 (37.7)	34 (8.3)	378 (91.7)		
≥3	204 (18.7)	20 (9.8)	184 (90.2)		
Duration of hypertension				0.360 (2)	0.836
<5 years	366 (33.5)	34 (9.3)	332 (90.7)		
5–10 years	356 (32.6)	31 (8.7)	325 (91.3)		
>10 years	370 (33.9)	37 (10.0)	333 (90.0)		
Blood pressure				14.090 (1)	**<0.001***
Controlled (<140/90 mmHg)	650 (59.5)	43 (6.6)	607 (93.4)		
Uncontrolled (≥140/90 mmHg)	442 (40.5)	59 (13.3)	383 (86.7)		
Frequency of follow-up per year				10.880 (1)	**0.001***
<3	512 (46.9)	32 (6.2)	480 (93.8)		
3–6	580 (53.1)	70 (12.1)	510 (87.9)		
Hypertension complications				35.760 (1)	**<0.001***
Yes	328 (30.0)	57 (17.4)	271 (82.6)		
No	764 (70.0)	45 (5.9)	719 (94.1)		
Family history of hypertension				0.070 (1)	0.790
Yes	769 (70.4)	73 (9.5)	696 (90.5)		
No	323 (29.6)	29 (9.0)	294 (91.0)		

*P<0.05

PA: physical activity

Predictors of depression among the patients with hypertension

Twelve significant variables in the SLogR analysis were included in the MLogR analysis. Although age, alcohol consumption, regular physical activity, daily fibre intake and frequency of follow-up per year were significant factors in the univariate analysis (**Tables 3** and **4**), these factors did not significantly contribute to the probability of having depression in the patients with hypertension in the multivariate analysis.

Table 3. Univariate analysis between depression and sociodemographic characteristics of the respondents

Factor	β	SE	Crude OR	95% CI		P-value
				Lower	Upper	
Age						
≤40 years	0.601	0.431	1.823	0.783	4.245	0.164
41–50 years	0.727	0.299	2.070	1.151	3.720	0.015
51–60 years	0.075	0.260	1.078	0.648	1.793	0.773
>60 years			1			0.065
Sex						
Male			1			
Female	0.000	0.210	1.000	0.662	1.509	0.999
Ethnicity						
Malay			1			**0.004***
Chinese	0.184	0.312	1.202	0.652	2.213	0.555
Indian	0.908	0.337	2.478	1.281	4.796	0.007
Others	1.324	0.708	3.760	0.939	15.051	0.061
Marital status						
Married			1			**0.001***
Widow	0.310	0.289	1.363	0.773	2.404	0.284
Divorced	1.080	0.474	2.945	1.162	7.462	0.023
Single	1.026	0.282	2.789	1.604	4.850	<0.001
Educational status						
No formal education			1			0.923
Primary education	0.061	0.502	1.063	0.398	2.843	0.903
Secondary education	−0.021	0.493	0.980	0.373	2.574	0.967
Tertiary education	−0.185	0.565	0.831	0.275	2.518	0.744
Employment						
Employed			1			0.560
Retired	0.281	0.274	1.324	0.773	2.267	0.306
Unemployed	0.528	0.429	1.695	0.731	3.931	0.219
Housewife	0.285	0.271	1.329	0.782	2.260	0.293
Household income						
<3000 RM			1			0.580
3000–5999 RM	−0.220	0.273	0.802	0.470	1.369	0.419
≥6000 RM	−0.390	0.531	0.677	0.239	1.918	0.463

*P<0.05; CI=confidence interval, OR=odds ratio

Table 4. Univariate analysis between depression and health behaviours and clinical characteristics of the respondents.

Factor	β	SE	Crude OR	95% CI		P-value
				Lower	Upper	
Smoking						
Yes	0.176	0.314	1.193	0.645	2.207	
No			1			0.574
Alcohol consumption						
Yes	0.473	0.253	1.605	0.978	2.634	
No			1			0.061
Heavy episodic drinking						
Yes	1.585	0.312	4.877	2.646	8.987	
No			1			**<0.001***

Table 4. (Continued)						
Factor	β	SE	Crude OR	95% CI		P-value
				Lower	Upper	
PA						
Yes			1			**0.034***
No	0.442	0.209	1.556	1.033	2.343	
Duration of PA						
<150 min/week	0.703	0.269	2.019	1.192	3.420	
≥150 min/week			1			**0.009***
Daily fibre intake						
Yes			1			**<0.001**
No	1.048	0.243	2.851	1.771	4.589	
Amount of fibre intake						
<2 servings/day	0.984	0.210	2.676	1.772	4.041	
≥2 servings/day			1			**<0.001**
BMI						
Normal (18.5–22.9 kg/m^2)			1			0.412
Underweight (<18.5 kg/m^2)	−0.070	0.648	0.933	0.262	3.320	0.914
Overweight (23.0–27.4 kg/m^2)	−0.162	0.292	0.851	0.480	1.508	0.580
Obese (≥27.5 kg/m^2)	0.236	0.285	1.266	0.724	2.213	0.408
No. of antihypertensive medication taken						
1			1			0.626
2	−0.221	0.235	0.802	0.506	1.271	0.348
≥3	−0.031	0.280	0.969	0.559	1.679	0.911
Duration of hypertension						
<5 years			1			0.836
5–10 years	−0.071	0.260	0.931	0.559	1.551	0.785
>10 years	0.082	0.250	1.085	0.665	1.771	0.744
BP						
Controlled (<140/90 mmHg)			1			**<0.001***
Uncontrolled (≥140/90 mmHg)	0.777	0.211	2.175	1.438	3.287	
Frequency of follow-up per year						
<3			1			**0.001***
3–6	0.722	0.223	2.059	1.331	1.331	
Hypertension complications						
Yes	1.212	0.212	3.361	2.219	2.219	
No			1			**<0.001***
Family history of hypertension						
Yes	0.061	0.230	1.063	0.667	1.670	
No			1			0.790

*P<0.05; CI=confidence interval, OR=odds ratio

Table 5 presents the factors associated with suspected depression after controlling for cofounders in the MLogR analysis. The participants aged 41–50 years had a 2.18-fold higher risk of suspected depression (AOR: 2.175; CI: 1.079–4.385); those with Indian ethnicity, 2.37-fold higher risk (AOR: 2.373; CI: 1.147–4.907); those who were divorced, 3.50-fold higher risk (AOR: 3.5; CI: 1.243–9.860); and those who were single, 2.24-fold higher risk (AOR: 2.241; CI: 1.182–4.251) than their counterparts. In terms of health behaviours, the participants who reported heavy episodic drinking had a 7.34-fold higher risk of suspected depression (AOR: 7.343; CI: 2.494–21.624); those who had a low physical activity level, 1.92-fold higher risk (AOR: 1.921; CI: 1.093–2.274); and those who had low fibre intake, 1.84-fold higher risk (AOR: 1.836; CI: 1.061–3.178) than their counterparts. Meanwhile, the participants who had uncontrolled BP (AOR: 1.800; CI: 1.134–2.858) and hypertension complications (AOR: 3.263; CI: 2.053–5.185) had a 1.80- and 3.26-fold higher risk than their counterparts.

Table 5. Multivariate analysis between depression and sociodemographic characteristics, health behaviours and clinical characteristics of the respondents.

Factor	β	SE	Adjusted OR	95% CI		P-value
				Lower	Upper	
Age						
≤40 years	0.429	0.514	1.535	0.560	4.206	0.405
41–50 years	0.777	0.358	2.175	1.079	4.385	**0.030**
51–60 years	0.124	0.296	1.132	0.634	2.023	0.674
>60 years			1			0.177
Ethnicity						
Malay			1			**0.038***
Chinese	0.223	0.351	1.250	0.628	2.487	0.525
Indian	0.864	0.371	2.373	1.147	4.907	0.020
Others	0.910	0.827	2.484	0.491	12.562	0.271
Marital status						
Married			1			**0.009***
Widow	0.577	0.328	1.780	0.936	3.386	0.079
Divorced/separated	1.253	0.528	3.500	1.243	9.860	0.018
Single	0.807	0.327	2.241	1.182	4.251	0.013
Alcohol consumption						
Yes	−0.710	0.468	0.492	0.197	1.230	
No			1			0.129
Heavy episodic drinking						
Yes	1.994	0.551	7.343	2.494	21.624	
No			1			**<0.001***
PA						
Yes			1			0.978
No	−0.007	0.265	0.993	0.591	1.668	
Duration of PA						
≥150 min/week			1			**0.023***
<150 min/week	0.653	0.287	1.921	1.093	3.374	
Daily fibre intake						
Yes			1			0.318
No	0.334	0.334	1.396	0.725	2.688	
Amount of fibre intake						
<2 servings/day	0.608	0.280	1.836	1.061	3.178	
≥2 servings/day			1			**0.030***
Blood pressure						
Controlled (<140/90 mmHg)			1			**0.013***
Uncontrolled (≥140/90 mmHg)	0.588	0.236	1.800	1.134	2.858	
Frequency of follow-up per year						
<3			1			0.778
3–6	0.236	0.249	1.266	0.778	0.778	
Hypertension complications						
Yes	1.183	0.236	3.263	2.053	5.185	
No			1			**<0.001***

*P<0.05; CI=confidence interval, OR=odds ratio

The model fitted well (Hosmer–Lemeshow test: P=0.275). Model assumption was met. Neither significant interaction nor multicollinearity problem was noted. The model explained between 18% (Cox and Snell R Square) and 22% (Nagelkerke R Square) of the variance in the depression group and correctly classified 90.8% of the cases.

Discussion

This study contributes to the limited literature estimating the prevalence and predictors of depression among patients with hypertension in primary care settings in Malaysia. The prevalence of suspected depression among the patients with hypertension in this study was lower than that (15.0–66.7%) in other studies that can be attributed to the variety of population background and tools used for depression.[8,10-12,17] The prevalence of depression was lower in the present study, as most participants had a Chinese ethnicity. This agrees with reports in Malaysian studies that Chinese ethnicity was associated with the lowest prevalence of depression among ethnicities.[18] The different cultures among multi-ethnicities in Malaysia have yielded varying findings of depression. Our study also excluded patients with mental illness or history of such, which might have contributed to the low prevalence of depression herein.

Despite the use of the same cut-off point for the PHQ-9 score, the prevalence of depression is much lower in our study than in the study by Mahmood et al. (40.1%).[12] This might be attributed to their small sample size and the notably lower socioeconomic status and prominently unhealthy lifestyle habits of their study population. Prathibha et al. reported a higher prevalence of depression (33.0%), as they used a lower PHQ-9 cut-off score of ≥6 points, and 51.6% of their participants had multiple comorbidities.[17] Al-Lugmani et al. reported the highest prevalence of depression among patients with hypertension (66.7%), which could be attributed to the fact that a large number of their participants had hypertension complications (35.0%) and that their sample size was relatively small (54 patients with hypertension). Furthermore, Al-Lugmani et al. used the Beck Depression Inventory to assess depression and enrolled patients with a history of depression and psychiatric therapy.[11]

Herein, the participants with hypertension complications had a 3.30-fold higher risk of undiagnosed depression than those without. Hypertension complications such as stroke can cause cognitive and functional impairments and physical disability and consequently lead to depression. Neurotransmitter changes due to cerebrovascular and ischaemic changes in the brain are linked to depression.[19] Heart failure or renal impairment can lead to functional decline, poor quality of life and depression.[20] The significant association found between hypertension complications and stroke in the present study is consistent with the findings by Al-Lugmani et al.,[11] although this study did not perform logistic regression analysis, and no further details regarding hypertension complications were reported.

We found that the patients aged 41–50 years were 2.18 times more likely to have suspected depression than their counterparts. This finding is similar to that by AlKhathami et al. that the highest prevalence of depression was noted among patients aged 30–40 years. Such observation can be attributed to the fact that younger patients face multiple challenges in life, including not only struggles in family life and work but also fear of illness-related complications.[21] This study found that Indians were 2.37 times more likely to have suspected depression, which is also reflected in Malaysia's Mental Health Care Performance Report 2016, showing that the highest prevalence of depression was found among Indians.[22] One probable contributing factor is the low socioeconomic status of Indians in Malaysia.

Herein, the participants who were divorced and those who were single had a 2.90- and 2.80-fold higher risk of suspected depression, consistent with previous reports that depression was higher among those who were divorced,[17] single[23] or unmarried.[10] Married patients have been reported to have a lower prevalence of depression, as marriage enables couples to cope better with emotional stress. Divorce is likely to confer many adaptive and emotional challenges and financial burdens that can lead to long-term stress and subsequently to depression.[23]

Our study found no sex influence on depression in the univariate analysis. This is in contrast to previous studies whereby sex was found to be a significant predictor of depression among patients with hypertension. Notably, the sample of these studies was predominantly women (54–72%).[10-11] The reason behind the higher prevalence of depression among women than among men remains unknown. Neupane et al. reported that the factors associated with a higher prevalence of undiagnosed depression among women included being overburdened with multiple social roles and responsibilities, having physiological changes (e.g. hormonal fluctuations), having genetic components that allow overlapping of risk factors for

both depression and cardiovascular disease and experiencing sex discrimination and sex-based violence.[8] Sherina et al. also revealed a higher prevalence of depression among women (12.1%) mainly owing to financial constraints, unsatisfactory relationships (family and career) and serious illnesses.[24] Our study showed that the differences could be attributed to the majority of the female participants being housewives and being old; nevertheless, they may be less burdened by social responsibilities, as most of them did not work, and their children were already adults. Furthermore, women are more likely to be diagnosed with depression than men, since they are less likely to seek help. Heavy episodic drinking was related to a 7.34-fold higher risk of suspected depression in our study, which is supported by many studies that showed a significant relationship between depression and alcohol intake among the general population.[25-26] The relationship between alcohol intake and depression is cyclical. Some people drink as a coping strategy when they are stressed, since the sedative effects of alcohol can distract them from their problems. However, in the long term, alcohol can trigger or worsen depression. Alcohol dependence and abuse can lead to detrimental financial consequences and relationship disharmony and consequently worsen depression. This can further lead to a damaging cycle of alcohol abuse to relieve depressive symptoms.

We also found that the participants who had low physical activity levels were 1.92 times more likely to have depression. Son et al. also revealed that low physical activity levels were associated with a 4.40-fold higher risk of depression.[27] The relationship between physical activity and depressive symptoms has been reported to be bidirectional. While exercise may alleviate depressive symptoms, depression can also be a barrier to engaging in physical activity.[28] Furthermore, engaging in exercises can widen a person's social circle as well as enhance body image, promote self-esteem and prevent depression.

Our respondents who had a low fibre intake had a 1.84-fold higher risk of suspected depression. This finding is consistent with that by Neupane et al. and is supported by evidence that the antioxidant effects of fruits and vegetables reduce the oxidative stress and inflammatory markers that are linked to the mechanism of depression.[8,29]

The participants with poorly controlled BP had a 1.80-fold higher risk of suspected depression in our study. Similar findings were reported by Prathibha et al.[17] This is because hypertension and depression share a common pathway: increased sympathetic tone and secretion of adrenocorticotropic hormone and cortisol. The lack of dopamine at key sites in the brain might lead to a high BP and trigger depression. Furthermore, uncontrolled BP can lead to cerebrovascular and ischaemic changes in the brain and further predispose individuals with hypertension to depression. Depression is also significantly linked to uncontrolled BP, as it can lead to feelings of hopelessness with being diagnosed with hypertension, frustration with treatment and non-adherence to medication.[5] Conversely, Alhamidah et al. found no significant association between BP control and depression. This may be because they used only the last BP reading to indicate uncontrolled BP10 as compared with our study in which the average value of the last three BP readings was used to determine BP control. We found that the number of antihypertensive medications was not significantly associated with depression among the patients, consistent with the findings by Al-Lugmani et al.[11] This can be attributed to the complexity of antihypertensive treatment, as most participants were treated with more than one drug (74.1%), and to the relatively small sample size (n=54). We did not explore the type of antihypertensive medication, which might affect the findings, as certain antihypertensive drugs can cause depression. Boal et al. found that both patients taking beta blockers and calcium antagonists had a 2.28-fold higher risk of depression.[30]

This study has some limitations. We were unable to determine the causal relationship of the associated factors with depression because of the cross-sectional study design. A positive screening test using the PHQ-9 warrants further diagnostic procedures before a final diagnosis of depression can be made. To our knowledge, despite its limitations, this study is the first study to determine the prevalence of undiagnosed depression among patients with hypertension and its associated factors in a Malaysian primary care setting

In conclusion, this study demonstrated that the prevalence of suspected depression among patients with hypertension in a primary

care clinic in Malaysia was 9%, which was associated with several risk factors including sociodemographic and lifestyle factors.

Acknowledgements

We would like to thank the Director General of Health Malaysia for permitting us to publish this article, the staff at Seremban Health Clinic for assisting in the data collection, Dr Salmiah and Dr Siti Zubaidah (family medicine specialists at Seremban Health Clinic) for allowing us to conduct this research in the clinic and all respondents for agreeing to participate in this study.

Author contributions

All authors conceived and designed the study and analysis. CSM collected the data and drafted the manuscript. AAR and LPY critically revised the manuscript for important intellectual content. All authors have agreed and are accountable on the final manuscript. AAR and CSM were actively involved in the manuscript submission and peer review process by responding to editor and reviewer queries. Both are available to respond to critiques of the work and will cooperate with any requests from the journal for data or additional information should questions about the paper arise after publication.

Ethical approval

Ethical clearance was obtained from University Putra Malaysia Ethical Committee (reference no. JKEUPM-2018-414) and National Medical Research Register [reference no. (NMRR-18-2584-43360)].

Conflicts of interest

The authors declare no conflicts of interest.

Funding

The study did not receive any specific grant from funding agencies in the public, commercial or not-for-profit sectors.

Data sharing statement

The datasets generated and analysed during the current study are available from the corresponding author upon reasonable request.

How does this paper make a difference in general practice?

- Depression among patients with hypertension is a burden in primary care settings.
- Indian ethnicity, divorce or singleness, heavy episodic drinking, low physical activity level, low fibre intake, uncontrolled blood pressure and presence of hypertension complications are predictors of depression among patients with hypertension.
- Early screening and intervention addressing modifiable risk factors are important.

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