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Association of mental health and medication adherence with blood pressure control in primary care patients with hypertension: a cross-sectional study

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A – Study Design, **B** – Data Collection, **C** – Statistical Analysis, **D** – Data Interpretation, **E** – Manuscript Preparation, **F** – Literature Search, **G** – Funds Collection

Summary **Background.** Uncontrolled blood pressure is associated with significant cardiovascular mortality and morbidity, and its management is often complicated by poor medication adherence and mental health disorders.
Objectives. This study aimed to evaluate the association of blood pressure control with psychological disorders and medication adherence among primary care patients with hypertension.
Material and methods. A cross-sectional study that included 478 hypertensive patients from five urban primary healthcare settings in Port Said governorate, Egypt. Socio-economic and clinical characteristics were collected, and all participants were screened for depression, generalised anxiety disorder, perceived stress and medication adherence using the Patient Health Questionnaire-9 (PHQ-9), Generalized Anxiety Disorder Scale-7 (GAD-7), 10-item Perceived Stress Scale (PSS-10) and General Medication Adherence Scale (GMAS). Hierarchical logistic regression analysis was used to assess predictors of blood pressure control. *P*-values < 0.05 were considered significant.
Results. 40.17% had uncontrolled blood pressure, and 44.8% had suboptimal adherence to antihypertensive medications. The prevalence estimates of depressive and anxiety symptoms were 33.7% and 28.9%, respectively. The mean PSS-10 score was 18.50 ± 6.34. Predictors of controlled blood pressure included optimal medication adherence (OR 2.518, $p < 0.001$), performing physical activity (OR 2.0, $p = 0.004$), having a higher number of target organ damage (OR 1.514, $p = 0.017$), using combined antihypertensive medications, (OR 1.392, $p = 0.006$), having lower anxiety symptoms (OR 0.453, $p = 0.013$) and being younger (OR 0.970, $p = 0.047$).
Conclusions. Symptoms of anxiety, not depression, and suboptimal medication adherence were associated with uncontrolled blood pressure. A multidisciplinary team approach should be utilised in the management of hypertensive patients to address individual patients' biopsychosocial factors.
Key words: depression, medication adherence, blood pressure monitors, anxiety.

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Background

Hypertension (HTN) is a global health problem that affects 24% and 20% of men and women, respectively [1]. Reducing the prevalence of uncontrolled blood pressure is one of the voluntary targets for noncommunicable diseases (NCD) that were set by the World Health Organization and national governments in 2013, which aimed at reducing the prevalence of uncontrolled blood pressure (BP) by 25% in 2025 [2]. The Ministry of Public Health and Population in Egypt adopted this target and planned a national strategy that relies on primary health care as one of the important pillars for achieving a 25% relative reduction in the prevalence of raised BP from 40% in 2012 to 30% by 2025 [3–5].

Previous studies showed that the rate of controlled BP is only 14% globally [6], and 10% in low- and middle-income countries [7]. In Egypt, a lower middle-income country, the percentage of BP control among Egyptian men and women with HTN was reported as 12% and 25%, respectively [8]. Uncontrolled BP is associated with multiple adverse health outcomes, including coronary heart disease, heart failure, cerebrovascular accidents, chronic kidney disease and dementia [9].

Adherence to antihypertensive medications is the cornerstone of BP control [10]. Suboptimal adherence to antihypertensive medications is commonly encountered with a worldwide prevalence of 45% [11], with an even higher rate of 63% among adults in low- and middle-income countries [12]. Strikingly, the prevalence of suboptimal adherence among primary care patients with HTN varied widely among different countries, with a reported rate of 9.9% in Romania, 32.6% in Egypt, 46.6% in Malaysia, 54.2% in the Democratic Republic of Congo, 57.8% in Saudi Arabia, 64% in Brazil and 65.2% in Indonesia [13–19].

Symptoms of depression and anxiety are prevalent in patients with HTN. A meta-analysis revealed that the prevalence of depression among hypertensive patients was 26.8% [20]. Other studies also reported variable degrees of depressive symptoms among hypertensive patients attending PHC at a rate of 10.7% in China [21], 19.6% in Saudi Arabia [22], 41% in India [23] and 48.5% in Nigeria [24]. Whereas for anxiety, 38.4% of PHC patients with HTN in Saudi Arabia had symptoms of anxiety [25] compared to 13.3% among older PHC patients with HTN in Malaysia [26].

Several meta-analyses suggested that depression, anxiety and chronic psychosocial stress increase the risk for HTN incidence [27–29]. Moreover, depression, anxiety and stress were identified as risk factors for developing cardiovascular disease (CVD), as well as working as barriers to treatment adherence [30]. Earlier research suggested a higher risk for uncontrolled BP in patients with HTN and comorbid depressive symptoms [31], although another study found that BP control was higher in hypertensive patients with depression irrespective of receiving antidepressant treatment or not [32]. Anxiety symptoms were also found to be significantly associated with deterioration in BP control during the COVID-19 pandemic [33]. Moreover, higher stress was also associated with suboptimal adherence to non-pharmacological treatment and poor BP control [34].

Based on the above epidemiological studies, it seems that there is a complex relationship between HTN, mental health disorder, and socio-economic characteristics of different patients that affect the management and outcome of HTN disease. However, most of the published literature was gathered from Western countries and English-speaking populations, while little is known about this association in economically challenged Arab-speaking countries. Therefore, it is important to use a culture-sensitive approach to elucidate this dynamic relationship.

Objectives

As PHC is considered the gatekeeper to the front door for the community for healthcare access, we conducted this study aiming to investigate the association between different psychological disorders, medication adherence and BP control, taking into account the unique socio-economic status and current healthcare system among hypertensive patients attending PHC settings in the Port Said governorate in Egypt. Understanding this relationship will help primary care physicians to plan their intervention to improve BP control at the community level.

Materials and methods

Design, sampling and setting

We conducted a cross-sectional study at five urban PHC settings affiliated with the General Authority of Healthcare in the Port Said governorate, Egypt, between November 2020 and August 2021. The following formula was used for calculating the sample size: $N = ([Z_\alpha + Z_\beta]/ 1/2 \log [(1 + r)/(1 - r)])^2 + 3$ [35]. The calculation was based on the Spearman correlation coefficient (rho = 0.307) between anxiety symptoms and systolic blood pressure measurement [SBP] (BP control), and this data was derived from a pilot study on 45 participants with α-error (Z_α) of 0.05 and β-error rate (Z_β) of 0.20. This was also enough to determine the frequency and predictors of BP control. The calculated sample size was 416 patients; however, the total sample size was 478 patients after adding 15% to compensate for non-response.

We used a convenient sampling technique to enrol participants. Inclusion criteria were the following: patients aged eighteen years or more, diagnosed with essential HTN for at least one year, receiving antihypertensive medications for at least 3 months without change and patients who agreed to provide written informed consent for participation. Exclusion criteria were having gestational diabetes or not being able to give consent, secondary to serious mental illness or cognitive impairment or refusal to participate. The Research Ethics Committee at the Faculty of Medicine, Suez Canal University, Ismailia, Egypt, approved the study (Ref No. 4113/2020). All participants gave written informed consent before participation.

Tools and measurements

All participants were interviewed. Collected data included sociodemographic, lifestyle, and clinical characteristics (e.g. age, gender, marital status, educational level, employment status and income, smoking status, exercise, duration of HTN (in years), HTN-related complications and current antihypertensive medications. Furthermore, PHQ-9, the GAD-7 and PSS-10 were used to evaluate symptoms of depression, anxiety and perceived stress, respectively [36–41]. In addition, GMAS was used for adherence to antihypertensive medications [42–44].

The PHQ-9 was used to measure depressive symptoms where each item was given a score from 0 to 3 (“not at all” to “nearly every day”, respectively). The total PHQ-9 score was calculated as the sum of all items’ scores, with a maximum score of 27. A total PHQ-9 score ≥ 10 showed high sensitivity and specificity for major depression. The tool is valid and reliable with Cronbach’s α of 0.89 [36]. The Arabic version of the PHQ-9 also showed satisfactory validity and reliability with a Cronbach’s α of 0.857 [38].

The GAD-7 was used to assess anxiety symptoms, with each item weighing a score from 0 to 3 (“not at all” to “nearly every day”, respectively). The sum of all items’ scores comprised a total GAD-7 score ranging from 0 to 21. A total GAD-7 score of ≥ 10 has a sensitivity of 89% and a specificity of 82%. The internal consistency of the GAD is excellent with a Cronbach’s α of 0.92. The scale also has good test-retest reliability with an Intra class correlation of 0.83 [37]. The Arabic version of the GAD-7 also demonstrated satisfactory validity and reliability with Cronbach’s α of 0.763 [38].

The PSS-10 questionnaire is a widely used instrument for measuring the perception of stress. It is a measure of the degree to which situations in one’s life are appraised as stressful over the past month. All 10 items are rated on a 5-point Likert-type scale, ranging from 0 (never) to 4 (very often). Answers to the four positively stated items (items 4, 5, 7 and 8) should be reversed before calculating the total score. All the item scores must be combined to produce a total score in the range of 0–40. A high score indicates a high degree of perceived stress, and no cut-off values were predefined [39, 40]. The Arabic version of the PSS-10 also demonstrated satisfactory validity and reliability [40, 41].

The original GMAS was developed and validated in the Urdu language. Its English version was later validated in Pakistan and Saudi. The scale includes 11 items. All items had four-level Likert-type responses, ranging from 0 (almost) to 3 (never). The total score of GMAS ranges from 0 to 33 [42–44]. In our study, a GMAS score ≤ 26 indicated suboptimal adherence, while a score of ≥ 27 was optimal adherence. The Arabic version of the GMAS showed adequate validity and reliability in Saudi patients with chronic illness [45].

The most recent measurements of blood pressure were obtained during patients’ visits to the PHC clinics. Controlled BP was defined as SBP/diastolic blood pressure (DBP) measurements less than 140/90 mm Hg [46]. Office BP measurements were conducted in alliance with the 2020 international society of HTN clinical practice guidelines [47] by trained nurses using validated BP machines.

Body weight (kg) and height (cm) were measured, while the body mass index (BMI) was calculated as the weight (kg)/height (metre^2). Patients with a BMI of 18.5–24.9, 25-29.9 or ≥ 30 were classified as normal, overweight or obese, respectively. Regular physical activity was defined as “performing at least 150 minutes of moderate-intensity aerobic physical activity, or at least 75 minutes of vigorous-intensity aerobic physical activity, or an equivalent combination of moderate- and vigorous-intensity activity throughout the week” [30].

Statistical analysis

Data management and statistical analyses were conducted using the Statistical Package for the Social Sciences (SPSS®) for Windows, version 25.0 (IBM Corporation, NY, USA). All categorical variables were summarised as frequencies and percentages (%). The distributions of continuous variables were tested for normality with the Shapiro-Wilk test. The median and interquartile ranges were used for non-normally distributed variables. The Spearman test was performed to estimate the correlation between SBP and DBP measurements, depressive symptoms, anxiety symptoms, perceived stress and medication adherence. The point biserial correlation coefficient (rpb) was measured to assess the correlation of perceived stress with blood pressure control. The Chi-squared or Fisher's Exact tests were used as appropriate to compare categorical data. Hierarchical logistic regression analysis was performed to assess predictors of BP control. p-values < 0.05 were considered significant in all statistical analyses.

Results

The study sample included 478 hypertensive patients with a mean age of 56.6 ± 9.7 years (range: 33–77 years), and 24.4% of them were aged ≥ 65 years. Most of the participants were females (65.9%), married (69.2%), had perceived insufficient family income (52.1%), were non-smokers or ex-smoker (87.7%) and were physically inactive (53.3%). Depressive and anxiety symptoms were present among 33.7% and 28.9% of the participants, respectively. The mean of the PSS-10 score was 18.5 ± 6.3 and ranged from 3 to 30 (The median was 19 and the interquartile range was (13–24). Nearly one-third (32%) of the participants had two or more HTN-related complications with coronary artery disease being the most reported complication (33.3%), while stroke was the least reported complication (5.9%). Most of the patients received two or more antihypertensive medications (68.2%). Suboptimal adherence to antihypertensive medications was stated in 44.8% of the sample, and 40.17% of the participants had uncontrolled BP.

Table 1 shows that BP control was significantly associated with socio-demographic characteristics such as younger age, male gender, being married, educational level, employment status and perceived sufficient family income. BP control was also significantly associated with regular physical activity, lower duration of HTN, normal BMI, absence of dyslipidaemia, lower number of target organ damage, absence of coronary artery disease, a higher number of antihypertensive medications, optimal adherence to antihypertensive therapy and lower symptoms of depression or anxiety (Table 2). Participants with uncontrolled BP reported significantly more perceived stress (rpb = -0.120, $p = 0.009$).

The SBP measurements had very weak positive correlations with the PHQ-9 (rho = 0.103, $p = 0.024$), GAD-7 (rho = 0.127, $p = 0.005$) and the PSS-10 total scores (rho = 0.091, $p = 0.048$), whereas the DBP measurements showed insignificant correlations with the PHQ-9, GAD-7 and PSS-10 total scores. Both the SBP and the DBP measurements demonstrated very weak and inverse correlations with the GMAS total scores (rho = -0.139, $p = 0.002$ and rho = -0.167, $p < 0.001$, respectively). The GMAS total scores were significantly and negatively correlated with the PHQ-9 (rho = -0.218, $p < 0.001$), GAD-7 (rho = -0.270, $p < 0.001$) and PSS-10 total scores (rho = -0.396, $p < 0.001$) (Table 3).

Table 4 demonstrates hierarchical logistic regression analysis for BP control. Model 1 included socio-demographic, lifestyle and clinical predictors. This was a significant model and accounted for 11.5% of the variation in BP control. In model 2, symptoms of depression (PHQ-9 ≥ 10), anxiety (GAD-7 ≥ 10) and perceived stress (PSS-10) were added, and in the predictive power of BP, control was improved as indicated by increasing R-square, which was also a significant model. In model 3, optimal adherence to antihypertensive medications (GMAS score ≥ 27) was added, which showed improvement in the predictive power of the model and an increase in the model R-square. This last model demonstrated that significant predictors for having controlled BP were younger age (OR 0.970, $p = 0.047$), being physically active (OR 2.0, $p = 0.004$), having a higher number of target organ damage (OR 1.514, $p = 0.017$), receiving a higher number of antihypertensive medications (OR 1.392, $p = 0.006$), suffering from fewer anxiety symptoms (OR 0.453, $p = 0.013$), perceiving higher stress (OR 1.064, $p = 0.018$) and having optimal adherence to antihypertensive medications (OR 2.518, $p < 0.001$).

Table 1. Association of blood pressure control with socio-demographic characteristics among the study participants ($n = 478$)

Variables	All participants ($n = 478$)	Uncontrolled ($n = 192$)	Controlled ($n = 286$)	Test value	p
Age (years)					
≥ 18 to < 65 years	362 (75.7%)	132 (68.8%)	230 (80.4%)	8.512	0.004*
≥ 65 years	116 (24.3%)	60 (31.3%)	56 (19.6%)		
Gender					
Male	163 (34.1%)	52 (27.1%)	111 (38.8%)	7.031	0.008*
Female	315 (65.9%)	140 (72.9%)	175 (61.2%)		
Marital status					
Single	6 (1.3%)	0 (0.0%)	6 (2.1%)	10.754	0.010**
Married	331 (69.2%)	122 (63.5%)	209 (73.1%)		
Divorced	10 (2.1%)	5 (2.6%)	5 (1.7%)		
Widow	131 (27.4%)	65 (33.9%)	66 (23.1%)		
Education level					
Illiterate	43 (9.0%)	20 (10.4%)	23 (8.0%)	10.646	0.014*
Less than secondary education	64 (13.4%)	27 (14.1%)	37 (12.9%)		
Secondary education	246 (51.5%)	110 (57.3%)	136 (47.6%)		
University or above	125 (26.2%)	35 (18.2%)	90 (31.5%)		

Table 1. Association of blood pressure control with socio-demographic characteristics among the study participants (*n* = 478)					
Variables	All participants (*n* = 478)	Uncontrolled (*n* = 192)	Controlled (*n* = 286)	Test value	*p*
Occupation					
Not-working (housewives, retired or unemployed)	200 (41.8%)	95 (49.5%)	105 (36.7%)	11.825	0.037*
Unskilled manual worker	24 (5.0%)	5 (2.6%)	19 (6.6%)		
Skilled manual worker	23 (4.8%)	10 (5.2%)	13 (4.5%)		
Trades	42 (8.8%)	17 (8.9%)	25 (8.7%)		
Semi-professional	81 (16.9%)	31 (16.1%)	50 (17.5%)		
Professional	108 (22.6%)	34 (17.7%)	74 (25.9%)		
Income (Patients' perceptions)					
Insufficient	249 (52.1%)	111 (57.8%)	138 (48.3%)	4.208	0.040*
Sufficient	229 (47.9%)	81 (42.2%)	148 (51.7%)		

* The Chi-squared statistic is significant at < 0.05; ** Fisher's Exact statistic is significant at < 0.05.

Table 2. Association of blood pressure control with lifestyle and disease characteristics among the study participants (n = 478)					
Variables	All participants (*n* = 478)	Uncontrolled (*n* = 192)	Controlled (*n* = 286)	Test value	*p*
Smoking					
Current smoker	59 (12.3%)	18 (9.4%)	41 (14.3%)	2.613	0.106
Non-smoker or ex-smoker	419 (87.7%)	174 (90.6%)	245 (85.7%)		
Physical activity	223 (46.7%)	67 (34.9%)	156 (54.5%)	17.822	< 0.001*
Duration of hypertension					
< 5 years	125 (26.2%)	33 (17.2%)	92 (32.2%)	13.349	0.001*
5–9 years	153 (32.0%)	69 (35.9%)	84 (29.4%)		
≥ 10 years	200 (41.8%)	90 (46.9%)	110 (38.5%)		
Target organ damage					
Not present	242 (50.6%)	85 (44.3%)	157 (54.9%)	7.862	0.049*
One target organ damage	83 (17.4%)	36 (18.8%)	47 (16.4%)		
Two target organ damage	89 (18.6%)	46 (24.0%)	43 (15.0%)		
Three or more target organ damage	64 (13.4%)	25 (13.0%)	39 (13.6%)		
Stroke	28 (5.9%)	11 (5.7%)	17 (5.9%)	0.010	0.922
Retinal haemorrhage	72 (15.1%)	33 (17.2%)	39 (13.6%)	1.132	0.287
Coronal artery disease	159 (33.3%)	74 (38.5%)	85 (29.7%)	4.027	0.045*
Heart failure	61 (12.8%)	25 (13.0%)	36 (12.6%)	0.019	0.889
Chronic kidney disease	30 (6.3%)	11 (5.7%)	19 (6.6%)	0.163	0.686
Peripheral artery disease	112 (23.4%)	53 (27.6%)	59 (20.6%)	3.115	0.078
Associated comorbidities					
Diabetes	216 (45.2%)	84 (43.8%)	132 (46.2%)	0.268	0.605
Dyslipidaemia	234 (49.0%)	108 (56.3%)	126 (44.1%)	6.836	0.009*
Depressive symptoms (PHQ ≥ 10)	161 (33.7%)	77 (40.1%)	84 (29.4%)	5.925	0.015*
Anxiety symptoms (PHQ ≥ 10)	138 (28.9%)	70 (36.5%)	68 (23.8%)	8.997	0.003*
Family history of hypertension	350 (73.2%)	145 (75.5%)	205 (71.7%)	0.865	0.352
BMI					
Normal	53 (11.1%)	22 (11.5%)	31 (10.8%)	11.111	0.004*
Overweight	179 (37.4%)	55 (28.6%)	124 (43.4%)		
Obesity	246 (51.5%)	115 (59.9%)	131 (45.8%)		
Antihypertensive medication					
Monotherapy	152 (31.8%)	70 (36.5%)	82 (28.7%)	12.861	0.005*
Dual therapy	186 (38.9%)	76 (39.6%)	110 (38.5%)		
Triple therapy	86 (18.0%)	36 (18.8%)	50 (17.5%)		
Quadrable therapy	54 (11.3%)	10 (5.2%)	44 (15.4%)		
Adherence to antihypertensive medications					
Suboptimal (GMAS ≤ 26)	214 (44.8%)	106 (55.2%)	108 (37.8%)	14.141	< 0.001*
Optimal (GMAS ≥ 27)	264 (55.2%)	86 (44.8%)	178 (62.2%)		

BMI – Body Mass Index; GAD-7 – 7-item Generalised Anxiety Disorder; GMAS – General Medication Adherence Scale; PHQ-9 – 9-item Patient Health Questionnaire; * The chi-squared statistic is significant at < 0.05.

Table 3. Correlation between systolic blood pressure, diastolic blood pressure, depressive symptoms, anxiety symptoms, perceived stress and medication adherence among the study participants (n = 478)

Variables	SBP	DBP	PHQ-9 score	GAD-7 score	PSS-10 score	GMAS score
SBP (mm Hg)	1					
DBP (mm Hg)	0.640**	1				
PHQ-9 score	0.103*	0.077	1			
GAD-7 score	0.127**	0.035	0.786**	1		
PSS-10 score	0.091*	0.056	0.760**	0.808**	1	
GMAS score	-0.139**	-0.167**	-0.218**	-0.270**	-0.396**	1

DBP – Diastolic Blood Pressure; GAD-7 – 7-item Generalised Anxiety Disorder; GMAS – General Medication Adherence Scale; PHQ-9, 9-item Patient Health Questionnaire; PSS-10, the 10-item Perceived Stress Scale; SBP – systolic blood pressure; ** Correlation is significant at a 0.01 level (2-tailed); * Correlation is significant at a 0.05 level (2-tailed).

Table 4. Hierarchical logistic regression models for prediction of blood pressure control among the study participants (n = 478)

Variables	Model 1		Model 2		Model 3	
	OR (95% CI)	*p*	OR (95% CI)	*p*	OR (95% CI)	*p*
Age (years)	0.977 (0.950–1.006)	0.122	0.974 (0.945–1.003)	0.073	**0.970 (0.941–1.000)**	**0.047***
Gender	0.740 (0.438–1.251)	0.261	0.710 (0.410–1.228)	0.221	0.795 (0.453–1.397)	0.426
Marital status	1.005 (0.630–1.603)	0.984	0.946 (0.588–1.520)	0.818	0.995 (0.612–1.615)	0.982
Education level	1.000 (0.863–1.159)	0.996	0.936 (0.801–1.095)	0.411	0.934 (0.795–1.097)	0.403
Occupation	0.950 (0.857–1.053)	0.331	0.954 (0.859–1.059)	0.376	0.947 (0.851–1.054)	0.317
Income	1.078 (0.706–1.645)	0.727	1.101 (0.717–1.692)	0.660	1.157 (0.748–1.791)	0.512
Smoking	1.251 (0.605–2.584)	0.546	1.394 (0.664–2.925)	0.380	1.572 (0.734–3.364)	0.244
Physical activity	**1.703 (1.086–2.670)**	**0.020***	**1.672 (1.058–2.641)**	**0.028***	**2.000 (1.242–3.219)**	**0.004***
Hypertension duration (years)	0.972 (0.925–1.022)	0.267	0.973 (0.925–1.023)	0.283	0.972 (0.923–1.024)	0.284
Number of target organ damage	1.270 (0.924–1.745)	0.141	1.367 (0.987–1.895)	0.060	**1.514 (1.078–2.128)**	**0.017***
Diabetes	0.921 (0.623–1.362)	0.680	0.937 (0.632–1.390)	0.746	0.953 (0.638–1.425)	0.816
Dyslipidaemia	0.700 (0.332–1.476)	0.349	0.618 (0.289–1.324)	0.216	0.559 (0.256–1.220)	0.144
BMI (kg/m^2)	0.994 (0.960–1.030)	0.754	0.998 (0.964–1.035)	0.931	0.995 (0.960–1.032)	0.795
Number of antihypertensive medications	**1.374 (1.094–1.725)**	**0.006***	**1.412 (1.120–1.780)**	**0.004***	**1.392 (1.098–1.763)**	**0.006***
Depressive symptoms			0.818 (0.477–1.405)	0.467	0.689 (0.394–1.205)	0.192
Anxiety symptoms			**0.482 (0.263–0.884)**	**0.018***	**0.453 (0.243–0.845)**	**0.013***
Perceived stress			1.024 (0.977–1.072)	0.327	**1.064 (1.011–1.119)**	**0.018***
Adherence to antihypertensive medications					**2.518 (1.605–3.951)**	**0.000***
-2 Log likelihood	601.533		593.205		576.564	
Degree of freedom, *p*-value	14, **< 0.001***		17, **< 0.001***		18, **< 0.001***	
Cox and Snell *R* Square	0.085		0.101		0.132	
Nagelkerke *R* Square	0.115		0.136		0.178	
Predictive accuracy (%)	65.3%		65.5%		65.9%	

BMI – body mass index; CI – confidence interval; OR – odds ratio; Reference categories for categorical variables, respectively, as appear in the table: male, not-married (including single, widow or divorced), illiterate, unemployed, insufficient income, not currently smoke (never smoke or ex-smoker), physically inactive, absent diabetes mellitus, absence of dyslipidaemia, depressive symptoms (the 9-item Patient Health Questionnaire < 10), and anxiety symptoms (the 7-item Generalised Anxiety Disorder Scale < 10), additionally suboptimal adherence to antihypertensive medications (General Medication Adherence Scale sore ≤ 26); * Statistically significant at $p < 0.05$.

Discussion

We conducted a cross-sectional study on 478 primary care patients with HTN in an urban area in Egypt on HTN control and its associated factors. Around one-third of the participants had concurrent depressive or anxiety symptoms, and four out of ten patients had suboptimal medication adherence. Anxiety symptoms were negatively associated with BP control, whereas patients' self-care behaviours, including adherence to medications and physical activity, were strong predictors for controlled BP.

Almost 6 out of 10 participants in this study had a controlled BP, which is higher than the rate reported in primary care clinics in Saudi Arabia (51%) [48], Ethiopia (43%) [49] and the United Kingdom (UK) (38%) [50]. In the latter study, the authors conducted a large population-based analysis on around 500 000 adult patients aged 40–69 years who were registered in the UK biobank. More than half of the participants had HTN, and nearly half of them were not aware that they had it. In fact, among patients already treated for HTN, just above one-third had controlled BP, and around two-thirds had sub-optimally controlled HTN, defined as BP less than 160/100 mm Hg [51]. The variability in the reported prevalence of controlled HTN in different studies could be attributed to many factors, including the study designs used, healthcare systems and variability in the study populations' lifestyles. However, the burden of uncontrolled HTN was persistently reported in both urban and rural communities in low-, middle- and high-income countries [52], which calls for an urgent need to address this global health threat.

In the current study, we found multiple socio-demographic features that were associated with uncontrolled BP, including age, gender, educational level and family income. However, only increased age was marginally but statistically significantly associated with poor BP control using hierarchical logistic regression analysis, which was consistent with other study results [48, 50]. This finding could be explained by the pathophysiological changes in the cardiovascular system that occur with increasing age, such as arterial stiffness and altered dynamics of blood flow that affect BP cuff measurements [52]. Additionally, older patients might have limited physical activity and a higher rate of sedentary lifestyle due to associated comorbidities and degenerative musculoskeletal symptoms. Based on this, primary care physicians should actively screen and manage uncontrolled BP in all adult patients irrespective of their age, gender or socioeconomic status.

Early use of pharmacological therapy to control BP is advocated in patients with comorbidities like diabetes, chronic kidney disease and cardiovascular disorders [53]. We found in this study that BP control increased in patients with a higher number of target organ damage. Similarly, the aforementioned study conducted in the UK found that having three or more comorbidities was the strongest predictor for having controlled BP. Interestingly, not all comorbidities associated with better BP control in that study were directly related to HTN, such as cardiovascular disease or diabetes, though having migraines or depression were also linked to a higher possibility of controlled HTN [50]. This observation might reflect the role of frequent interactions with the healthcare system and/or providing more aggressive management of HTN in patients with other comorbidities.

We also found that the rate of controlled BP was higher in patients receiving a higher number of antihypertensive medications, which is consistent with international treatment guideline recommendations that advise an initial combination of antihypertensive medications for most patients with HTN [46, 53]. An earlier meta-analysis concluded that using a combination of drugs from two different classes was five times more effective in lowering BP compared to doubling the dose of a single medication [54]. However, the use of multiple tablets could jeopardise patients' adherence to medications. Gupta et al. performed a meta-analysis on the use of free-drug combinations versus a fixed-dose combinations of antihypertensive medications and found a significant improvement in medication compliance in patients using fixed-dose combination tablets, in addition to a non-significant trend toward favourable BP control and adverse effect profiles [55]. Based on these findings, primary care physicians should be encouraged to use combination tablets to improve adherence to medications and BP control in patients with HTN.

As shown in this study, patient self-care in the form of adherence to medication and physical activity was linked to a higher probability of having controlled BP. Although a previous meta-analysis showed a high rate of medication nonadherence in patients with HTN in general, this rate was almost doubled in patients with uncontrolled BP [56]. Moreover, many patients who were initially diagnosed with resistant HTN were found to have poor medication adherence, which was proven both clinically and biochemically [57]. Interestingly, a large prospective cohort study revealed a strong association between medication adherence and lower cardiovascular disease events and BP burden over a median follow-up period of 3.5 years [58]. Nonadherence to pharmacological and nonpharmacological HTN interventions is a multifactorial process that needs a team-based approach for optimal management [57]. Strategies that improve adherence include reducing polypharmacy, habit-based and behavioural-based interventions and a multidisciplinary team approach that utilises other healthcare workers, such as pharmacists and nurses [59].

An earlier systematic review and meta-analysis by Khatib et al. on barriers to HTN management found that stress, depression and anxiety were the most frequently reported patient barriers to follow a healthy lifestyle [60]. Likewise, this study showed a reversed association between medication adherence and depressive symptoms, anxiety symptoms, as well as perceived stress. However, upon further analysis, only anxiety symptoms were significantly associated with uncontrolled BP. Several mechanisms were suggested to underlie this complex relationship between anxiety and HTN, including increased sympathetic activity, plasma renin activity and vascular resistance [61]. Anxiety symptoms were linked to higher nocturnal and early morning BP readings among hypertensive patients with anxiety compared to patients with HTN without anxiety symptoms, a finding which could potentially increase the risk for cardiovascular events [62]. The beneficial effects of pharmacological and nonpharmacological therapy of anxiety on BP control in hypertensive patients were also suggested by several studies [63–65]. Diazepam had comparable efficacy to sublingual captopril in a small trial on 34 patients presenting to the emergency unit with hypertensive urgency [63]. Another study found that the serotonin reuptake inhibitor fluoxetine was more effective in reducing BP than moxonidine in patients with HTN and comorbid panic disorders [64]. These associations between HTN and anxiety disorders appear to have biological connections, which emphasise the importance of incorporating early diagnosis and management of anxiety disorders in the treatment plan of patients with HTN.

Symptoms of depression were more prevalent in patients with uncontrolled BP in this study, but this observation was not confirmed after controlling other variables. Earlier literature showed mixed results as well. Rubio-Guerra et al. found a higher risk for uncontrolled BP in hypertensive patients with depression [66], whereas Wiehe et al. reported no association between the two variables [67]. On the other hand, Mejia-Lancheros et al.'s study suggested a higher rate of controlled BP among hypertensive patients with depression [32]. The impact of treating depression in hypertensive patients was also inconsistently reported. While a previous longitudinal cohort study found that using antidepressant therapy in hypertensive patients with comorbid depression was associated with a favourable effect on SBP and DBP readings compared to the control group [68], a subsequent study by Breeden et al. on the effect of antidepressant therapy in patients with treatment-resistant HTN did not show a significant association between the two variables after accounting for traditional risk factors for HTN [69].

Regarding perceived stress and uncontrolled BP in our population, the bivariate analysis showed a weak association between the perceived stress score and uncontrolled BP, but this association was reversed to a weak positive relationship after hierarchical logistic regression analysis. This surprising finding could be explained by having the true value of the association very close to zero. Previous studies also showed inconsistent results on this association. Lu et al. found a higher prevalence of HTN among patients with high levels of perceived stress compared to patients with low levels of perceived stress [70], while other studies did not show an association between perceived stress and HTN [71]. Nevertheless, Miguet et al. concluded that general stress was associated with lower BP, independent of lifestyle factors [72]. Despite having unclear associations between depression, perceived stress and BP control, a holistic approach to hypertensive patients in primary care necessitates incorporating patients' psychosocial factors into the treatment plan. Another interesting study showed that certain psychotherapeutic interventions showed a favourable effect on BP control in patients with HTN without changing hypertensive medications, which stresses the importance of identifying and addressing psychological disorders in patients with HTN [73].

This study's results added to our understanding of the prevalence of uncontrolled BP and concomitant psychological health problems and their relationship with medication adherence in an urban PHC setting in Egypt. However, these results should be interpreted carefully considering the following limitations: first, the cross-sectional study design will only allow for the description of the association without establishing causality or identifying the direction of this association, which is better defined in longitudinal studies. Second, we collected data from patients presenting to primary care, who are likely different from patients treated in secondary or tertiary care. Nevertheless, most patients with HTN are treated in PHC, and these results help to provide evidence-based guidance in planning HTN management interventions. Third, we used office BP readings as a measure for BP control, which could be affected by white-coat HTN and/or patients' diurnal variations in BP. However, BP measurements were done by trained nurses using validated machines and by following good clinical practice guidelines.

Conclusions

The prevalence of uncontrolled BP, depressive and anxiety symptoms, perceived stress and poor medication adherence was high among adult patients with HTN treated in the PHC of an urban area in Egypt. Older age and anxiety symptoms were more likely associated with poor BP control, whereas optimal medication adherence, regular physical activity, having a higher number of target organ damage and treatment with multiple antihypertensive medications were all associated with properly controlled BP.

Considering the complexity of medication adherence and the high rate of comorbid mental health disorders among patients with HTN, primary care physicians should take into consideration patients' socio-economic and psychological factors in the treatment plan for hypertensive patients. This integrated and comprehensive care should be optimally delivered through a multidisciplinary team that utilises primary care physicians, nurses, pharmacists, social workers, health educators, dietitians and psychotherapists.

Healthcare policymakers should provide educational programmes and prioritise resources for patients and healthcare workers in order to combat poor adherence to medications and therapeutic lifestyle modifications, as well as expand mental health support services for the community. Future studies are needed to determine the most effective and applicable interventions that target these areas at the PHC level.

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