

Patterns and determinants of treatment compliance among hypertensive patients

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نمط ومحددات الالتزام بالعلاج في المرضى المصابين بفرط ضغط الدم
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الخلاصة: تم استخدام تحليل التحوُّف اللوجستي للوصول إلى المنبئات بالالتزام بنمط الحياة والمداواة في المرضى المصابين بفرط ضغط الدم. فقد تم إجراء انتقاء عشوائي ثم مقابلات لعدد من المرضى الذين يرتادون عيادات التأمين الصحي من أجل إعادة وصف الدواء (وعدددهم 316 مريضاً). وقد تمت السيطرة على ضغط الدم في 53.2% من المرضى فيما كان 25.9% منهم غير ملتزمين بالعلاج. وتتمثل أهم معوقات الالتزام بالعلاج بالإحساس بأن الضغط عاد طبيعياً، ونسيان أخذ الدواء، وبفترات التوقف عن الدواء، والآثار الجانبية للدواء. كما أن بعض المرضى لم يلتزموا بالامتناع عن التدخين (43.6%)، أو تخفيض الوزن (59.3%)، أو إنقاص الملح في الغذاء (22.4%) أو إنقاص الدهون (26.5%). وأكثر المعوقات شيوعاً المفاهيم الخاطئة بشأن التوقف عن التدخين وتكلفة إعداد أطباق خاصة. أما المنبئات المستقلة بالالتزام فتمثل في السيطرة على ضغط الدم، وتعديل النظام الغذائي، والآثار الجانبية للأدوية وإدراك مزايا التدبير العلاجي وقابلية الإصابة بالأمراض.

ABSTRACT Logistic regression analysis was used to identify predictors of pharmacological and lifestyle compliance among hypertensive patients. Patients attending health insurance clinics for prescription refills were randomly selected and interviewed ($n = 316$). Blood pressure was controlled for 53.2% of patients but 25.9% were non-compliant with medication. Common barriers to compliance were: feelings of normal blood pressure, forgetfulness, drug holidays and drug side-effects. Patients were non-compliant with smoking cessation (43.6%), weight reduction (59.3%), and dietary salt (22.4%) and fat restriction (26.5%). Misconceptions about smoking cessation and costs of preparing special dishes were common. Independent predictors of compliance were: controlled blood pressure, diet modification, drug side-effects, and perceptions of management benefits and susceptibility to related complications.

Caractéristiques et déterminants de l'observance thérapeutique chez les patients hypertendus

RESUME L'analyse de régression logistique a été utilisée pour identifier les facteurs prédictifs de l'observance pharmacologique et comportementale chez les patients hypertendus. Des patients consultant dans les centres relevant de l'organisme d'assurance-maladie pour le renouvellement de leur ordonnance ont été sélectionnés de manière aléatoire et interrogés ($n = 316$). La pression artérielle était contrôlée pour 53,2 % des patients mais 25,9 % ne suivaient pas leur traitement. Les obstacles courants à l'observance étaient les suivants : l'impression d'avoir une pression artérielle normale, l'oubli, l'interruption momentanée du traitement et les effets secondaires des médicaments. Les patients ne se conformaient pas au sevrage tabagique (43,6 %), à l'exigence de perdre du poids (59,3 %), aux restrictions alimentaires concernant le sel (22,4 %) et les graisses (26,5 %). Les idées fausses concernant le sevrage tabagique et le coût de la préparation de plats spéciaux étaient courantes. Les facteurs prédictifs indépendants de l'observance étaient les suivants : une pression artérielle contrôlée, une modification de l'alimentation, la perception des avantages de la prise en charge et la sensibilité à la maladie.

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Introduction

Hypertension is a widespread health problem affecting nearly 20% of the population in most countries [1]. Data from the Egyptian Hypertension Society indicate that Egypt has the highest prevalence rate of hypertension in the world [2]. In 1991, a survey of 6733 individuals aged 25 years and older revealed that 31.3% of women and 29.7% of men were affected by the disease [3]. With these high rates of prevalence in a population exceeding 60 million, more than 6.5 million people require antihypertensive therapy [2].

One of the greatest challenges for health care providers in Egypt is not so much to identify patients with hypertension but rather to bring them under care and assist them to achieve blood pressure control. Only 23.9% of identified patients are receiving treatment and only 8% have their blood pressure under control [2]. It has been postulated that achieving blood pressure control is hampered by poor patient compliance with treatment [4-7], which suggests that patients are unable to stick to a management plan that includes the regular intake of medications as well as lifestyle modifications [8].

Generally, adherence to a medical regimen is most likely to be a problem in chronic therapy, when the perceived benefits of therapy are not readily apparent. Hypertension is a classic example of such a disease [4]. Poor patient compliance, to the extent of losing hypertensive control, can reverse the beneficial effects on stroke, cardiovascular diseases and hypertensive nephropathy [9], with serious financial implications. The costs are even higher if we consider that non-compliance negates the efforts invested in screening, diagnosis and counseling of hypertensive patients [8].

Despite decades of research, predictors of treatment non-compliance remain unclear [10]. Hence, the present study carried out in October 2001 investigated the impediments to pharmacological and non-pharmacological compliance among patients with hypertension, and identified the predictors of compliance of these using the health belief model as a theoretical framework.

Methods

The target population was hypertensive patients attending the Health Insurance Organization clinics in Alexandria for their monthly prescription refills. Patients in this type of care have complete and accessible records of their health status from the start of service to the present time. A multistage random sampling technique was used to select one health insurance polyclinic from each region and one internal medicine clinic from each polyclinic in Alexandria. Six clinics were chosen and 10% of patients attending for prescription refills were enrolled.

All participants were interviewed with a questionnaire consisting of four sections. Section 1 collected sociodemographic information including age, sex, marital status, educational attainment and occupation.

Section 2 collected a detailed health history about the onset of the disease and method of discovery. Medical records of the participants were reviewed to determine the presence of associated complications as well as other unrelated chronic health problems based on the diagnosis made by the treating physicians. This was in addition to the measurement and recording of blood pressure following World Health Organization guidelines [1]. For all

participants, the recorded blood pressure reflected the effect of the last dose of medication taken the previous day (as the first morning dose was usually postponed until the check-up was completed). Accordingly, controlled blood pressure was defined as a systolic of ≤ 140 mmHg and a diastolic of ≤ 90 mmHg.

Section 3 investigated pharmacological and non-pharmacological compliance. Pharmacological compliance was determined by reviewing participants' records for prescribed medications, i.e. number and classes of antihypertensive drugs, number of pills and dose frequency. Participants were asked about the number of pills they had missed during the previous month and the barriers for complying with the recommended schedule.

Participants were classified according to their compliance into two groups. Compliers were those who were complying fully (not missing a single dose) or partially (taking 90% or more of the prescribed pills). Non-compliers were those taking less than 90% of the prescribed pills. A limit of $\geq 90\%$ was set for compliance as this was the level significantly associated with controlled blood pressure among the studied population. This methodological approach was similar to that used by Sackett et al. [11], even though in that study patients achieved blood pressure control at 80% pharmacological compliance.

Non-pharmacological compliance with treatment includes the ability of the patient to maintain a healthy lifestyle, including smoking cessation, ideal weight, reduction of dietary fat and salt and regular exercise. Participants were asked about their lifestyle before and after the illness as well as the perceived barriers to lifestyle modification. Non-compliers were those whose lifestyles

did not conform to the doctor's recommendations.

In section 4, the knowledge and perceptions of the participants were collected. Participant's knowledge of hypertension, its nature, the role of treatment and associated complications was measured with 5 questions. Three questions were answered with either 'no' (scored 1) or 'yes' (scored 2). For the other 2, patients were requested to name complications associated with hypertension and means of achieving controlled blood pressure. For these questions, 'don't know' was scored 0 and each correct answer was scored 1. The score on this scale ranged from 3 to 17 and higher scores reflected better knowledge (Cronbach alpha reliability = 0.5497). Participant's perceptions were measured with 13 questions having 3 possible answers: 'don't agree' (scored 1), 'somewhat agree' (scored 2) and 'strongly agree' (scored 3). Higher scores reflected better perceptions. Three types of perceptions were examined; perceptions of the dangers of the disease (4 questions, scores from 4–12, Cronbach alpha reliability = 0.5227); perceptions of benefits of adherence to the management plan (7 questions, scores from 7–21, Cronbach alpha reliability = 0.7106); and perceptions of susceptibility to adverse consequences of the disease (2 questions, scores from 2–6, Cronbach alpha reliability = 0.9121).

Data were analysed with SPSS, version 8. Mean, standard deviation, odds ratio and corresponding 95% confidence interval were computed. Logistic regression analyses were used to model patient compliance as a function of demographic characteristics, medical condition, non-pharmacological compliance, knowledge and perceptions.

Results

A total of 316 patients were enrolled in this study. More than half (59.8%) were men; 40.2% were women. Their ages ranged from 35 to 83 years (mean 59.39 years \pm standard deviation 9.17). Nearly two-thirds of the participants (67.8%) were married, 29.7% were widowed and the remainder were divorced (1.9%) or single (0.6%).

The highest proportion (40.2%) of participants were illiterate or just able to read and write. Another 12.3% had finished basic education, 26.6% held a high school certificate and 20.9% were university graduates. Just less than half of the men (47.1%) were professional or semiprofessional, 20.7% were skilled or semiskilled workers and 24.3% were unskilled or manual labourers. Only a few (7.9%) were drivers or traders. At the time of the study, 64.6% were pensioners. Of the women, 54.3% were housewives and 45.7% were working women. Of the latter, 62.1% ($n = 36$) were still working at the time of the study and 37.9% ($n = 22$) were pensioners.

The medical histories of the participants were collected (Table 1). The mean duration of hypertension of the participants was 10.24 ± 7.74 years (range 0.25–40). For nearly two-fifths, the disease was silent and discovered accidentally while seeking care for other ailments (36.1%) or during health check-up at the work place (3.8%). Just over half (53.2%) of the participants achieved controlled blood pressure and nearly one-third (34.5%) suffered hypertension-related complications, the most common being cardiac problems (99/109, 90.8%). The mean duration of complications was 7.41 ± 5.73 years (range 0.25–25). Hospitalization as a result of hypertension or related complications was reported by 21.8% of the participants. Eight patients (2.5%) had been recently hospitalized for a

Table 1 Medical histories of participants with hypertension

Medical history	No. ($n = 316$)	%
<i>Method of discovery</i>		
During regular check-up	12	3.8
During medical consultation for other cause	114	36.1
During medical consultation for related symptoms	190	60.1
<i>Blood pressure</i>		
Controlled	168	53.2
Uncontrolled	148	46.8
<i>Hypertension-related complications</i>		
Absent	207	65.5
Present*	109	34.5
Cardiac	99	
Neurological	14	
Renal	5	
<i>History of hospitalization</i>		
Ever	69	21.8
Recent (previous 3 months)	8	2.5
Hypertension crisis	4	
Cardiac complications	2	
Neurological complications	1	
Renal complications	1	
<i>Presence of other disease</i>		
Absent	149	47.2
Present*	167	52.8
Diabetes mellitus	104	62.3
Arthritis	31	18.6
Bronchial asthma	26	15.6
Gout	16	9.6
Liver and gall bladder problems	10	5.9
Others ^b	9	5.4

*Categories are not mutually exclusive.

^bOthers include malignancy, hyperthyroidism, disseminated sclerosis, parkinsonism, peptic ulcer and epilepsy.

$n =$ total number of participants.

mean duration of around 5 days; hypertensive crisis was the reason for half of cases (4/8). The mean duration of hospitalization was 5.88 ± 4.64 days (range 2–15). (Table 1).

Apart from hypertension, 52.8% of participants had other chronic disorders, including diabetes mellitus (62.3%), arthritis (18.6%) and bronchial asthma (15.6%) (Table 1).

As regards pharmacotherapy, three-quarters (75.0%) of the participants were managed with a single drug while the others were receiving a combination of 2 (23.4%) or 3 (1.6%) drugs of different classes. A single morning dose was recommended for 55.1% of the patients while 44.3% were on twice daily doses (Table 2).

Reviews of the medical records of the participants indicated that 92.1% attended the clinic regularly for prescription refills. According to statements of the participants, nearly half of them were either non-compliers (25.9%) or partial compliers (22.2%). The most frequently stated barrier to full compliance was feeling that blood pressure was normal (36.2%), followed by forgetfulness (34.8%), wanting a 'drug holiday' (11.8%) and wanting to avoid side-effects (10.5%). Only 9.2% of the participants were unable to identify any barriers (Table 2).

The behaviour of participants in monitoring blood pressure and lifestyle before and after the diagnosis of hypertension were assessed (Table 3). Before hypertension was diagnosed, a small proportion were concerned about checking their blood pressure either from time to time (11.1%) or regularly (1.6%). After the illness, less than a quarter (24.7%) checked their blood pressure regularly, on average every 10 days (mean 10.45 ± 5.15 days), at a nearby pharmacy (53.8%), a physician's office (17.9%), a neighbour's house or the work-

Table 2 Pharmacological management of participants with hypertension

Pharmacological management	No. (n = 316)	%
<i>Prescribed classes of drugs^a</i>		
ACE inhibitors	110	34.8
Adrenergic inhibitors	106	33.5
Beta-blockers	87	27.5
Diuretics	56	17.7
Calcium channel blockers	36	11.3
Others ^b	4	1.3
<i>Number of drugs</i>		
1	237	75.0
2	74	23.4
3	5	1.6
<i>Dose frequency per day</i>		
1	174	55.1
2	140	44.3
3	2	0.6
<i>Compliance with timely prescription refill</i>		
Compliant	291	92.1
Non-compliant	25	7.9
<i>Compliance with pharmacological management</i>		
Fully compliant	164	51.9
Partially compliant	70	22.2
Non-compliant	82	25.9
<i>Perceived barriers to pharmacological compliance^c (n = 152)</i>		
No barriers	14	9.2
Feeling blood pressure is normal	55	36.2
Forgetfulness	53	34.8
Drug holiday	18	11.8
Avoidance of side-effects	16	10.5
Dislike medications	4	2.6
No improvement with treatment	3	1.9
Sharing drugs with another patient	1	0.6

^aCategories are not mutually exclusive.

^bOthers include vasodilators and alpha 1 receptor blockers.

ACE = angiotensin-converting enzyme.

n = total number of participants.

Table 3 Patient behaviours before and after diagnosis of hypertension

Patient behaviours	%	Patient behaviours	%
<i>Monitoring blood pressure</i>		<i>Consumption of saturated fat</i>	
Before (n = 316)		Before (n = 316)	
Never	87.3	No	25.0
From time to time	11.1	Yes	75.0
Regular	1.6	After (n = 237)	
After (n = 316)		Refrained	21.5
Regular	24.7	Reduced	56.1
Prescription refill	75.3	Followed the same pattern	22.4
Barriers to regular monitoring (n = 238)*		Barriers to modification (n = 53)*	
No barriers	21.8	Preference	83.0
Controlled blood pressure	29.4	Unable to prepare separate dishes	15.1
Symptoms experienced	28.5	Don't know the danger	5.7
Cost of monitoring	19.7	<i>Consumption of excess salt</i>	
No nearby source or lack of time	5.9	Before (n = 316)	
<i>Smoking</i>		No	16.5
Before (n = 316)		Yes	83.5
Non-smoker	68.0	After (n = 264)	
Smoker	32.0	Refrained	16.7
After (n = 101)		Reduced	56.8
Stopped	36.6	Followed the same pattern	26.5
Reduced	19.8	Barriers to modification (n = 70)*	
Followed the same pattern	43.6	Preference	95.7
Barriers to modification (n = 44)*		Inability to prepare separate dishes	2.8
Believe habit cannot be renounced	54.5	Don't know the danger	2.8
Being a light smoker	18.2	<i>Regular exercise</i>	
Psychological pressure	18.2	Before (n = 316)	
Lack of will power	9.1	Yes	33.9
Not related to the illness	2.2	No	66.1
<i>Weight</i>		After (n = 316)	
Before (n = 316)		Yes	21.2
Non-obese	47.2	No	78.8
Obese	52.8	Barriers to regular exercise (n = 249)*	
After (n = 167)		No barriers	5.6
Trying to reduce weight	40.7	Poor general condition	52.6
Not trying to reduce weight	59.3	Lack of time	39.3
Barriers to weight reduction (n = 99)*		Don't know the importance	7.6
No obstacles	12.1	Lack of place or company	1.2
Unable to prepare separate dishes	29.2		
Don't know the danger	26.2		
Tried with no success	18.2		
Like eating	15.1		
Not eating much	3.1		

*Categories are not mutually exclusive.
n = total number of participants.

place (28.3%). The remaining participants (75.3%) had their blood pressure checked every 30 days at the time of prescription refills. The commonly stated barriers to regular checking were that blood pressure was controlled (29.4%), belief that they could recognize the symptoms of elevated blood pressure (28.5%) and the cost involved in regular monitoring (19.7%) (Table 3). It is worth noting that 72.2% of the participants reported experiencing symptoms once their blood pressure was elevated.

Nearly one-third (32.0%) of the participants were smokers before the illness. Of these, 72.0% were advised by the physician to stop after the illness and just less than half (43.6%) were still smoking. The most commonly stated barriers to giving up smoking were: the belief that smoking is a habit that cannot be renounced (54.5%), being a light smoker (18.2%) or the need to cope with psychological pressures (18.2%) (Table 3).

Before hypertension was diagnosed, 52.8% of the participants were obese. After the illness 40.7% of them were trying to reduce their weight. For the remaining 59.3%, the most frequently cited barriers to weight reduction were: inability to prepare separate dishes for the family (29.2%), being unaware of the danger (26.2%), or having tried but never succeeded (18.2%) (Table 3). Only 30.7% of patients stated that the treating physician emphasized the importance of achieving and maintaining an ideal weight.

For the majority of the participants, prepared dishes were characterized by excessive use of saturated fat (75.0%) or salt (83.5%). After the illness, more than three-quarters of patients modified their diet. In fact, the majority of patients admitted that they had been instructed to reduce dietary

salt (91.5%) and fat (69.6%); preference for such dishes was the barrier stated by the great majority of the participants who were not following a healthy diet (Table 3).

Only 33.9% of the participants were exercising regularly before the illness. After the illness, this fell to 21.2%. For 52.6% of the participants who were leading a sedentary life, their poor health condition was the barrier to exercise (Table 3). Only 31.3% of the participants reported that the treating physician emphasized the value of regular exercise.

Univariate logistic regression analysis of the predictors of pharmacological compliance is given in Table 4. No significant differences were observed between compliers and non-compliers regarding their demographic characteristics except for educational attainment. Participants who held a university degree were 2.8 times more likely to comply with the prescribed pharmacotherapy (Table 4).

In respect to their medical condition and pharmacological management, compliers and non-compliers were similar in terms of duration of the original illness and presence of other medical problems. However, the participants complying with pharmacotherapy were nearly twice as likely to be free from related complications and almost 4 times more likely to have a controlled blood pressure. On the other hand, non-compliers were 8 times more likely to suffer drug side effects. Compliers were more likely to be on a single daily dose regimen yet this difference was not significant. No significant difference was observed between the two groups regarding the number of anti-hypertensive drugs prescribed (Table 4).

Compliers with pharmacotherapy were more likely to comply with lifestyle modification including smoking cessation, and restriction of dietary salt and fat. Also

Table 4 Univariate logistic regression analysis of the predictors of pharmacological compliance among participants with hypertension

Predictor	Compliers (n = 234)		Non-compliers (n = 82)		Odds ratio (95% CI)	P-value
Mean age ± s (years)	59.05 ± 9.15		60.37 ± 9.23		0.98 (0.95–1.01)	0.2600
Mean duration of illness ± s (years)	10.29 ± 8.35		10.07 ± 5.68		1.00 (0.97–1.03)	0.8288
	No.	%	No.	%		
Sex						
Female*	88	37.6	39	47.6		
Male	146	62.4	43	52.4	1.50 (0.90–2.50)	0.1147
Marital status						
Single*	74	31.6	28	34.1		
Married	160	68.4	54	65.9	1.12 (0.65–1.91)	0.6743
Education						
Illiterate/read and write*	88	37.6	39	47.6		
Primary/preparatory	29	12.4	10	12.2	1.28 (0.57–2.89)	0.5445
Secondary	60	25.6	24	29.2	1.10 (0.60–2.02)	0.7399
University	57	24.4	9	11.0	2.80 (1.26–6.23)	0.0113
Number of drugs						
>1*	59	25.2	20	24.4		
1	175	74.8	62	75.6	0.95 (0.53–1.72)	0.8822
Dose frequency per day						
>1*	98	41.9	44	53.7		
1	136	58.1	38	46.3	1.61 (0.96–2.66)	0.0661
Drug side-effects						
Present*	3	1.3	8	9.8		
Absent	231	98.7	74	90.2	8.32 (2.15–32.19)	0.0021
Blood pressure						
Uncontrolled*	90	38.5	58	70.7		
Controlled	144	61.5	24	29.3	3.86 (2.24–6.65)	0.0000
Complications						
Present*	72	30.8	37	45.1		
Absent	162	69.2	45	54.9	1.85 (1.10–3.09)	0.0195
Other illness						
Present*	123	52.6	44	53.7		
Absent	111	47.4	38	46.3	1.04 (0.63–1.73)	0.8644
Smoking						
Non-compliant*	40	17.1	58	70.7		
Compliant	194	82.9	24	29.3	2.01 (1.12–3.60)	0.0196
Ideal weight						
Non-compliant*	68	29.1	31	37.8		
Compliant	166	70.9	51	62.2	1.48 (0.87–2.52)	0.1430

Table 4 Univariate logistic analysis of the predictors of pharmacological compliance among participants with hypertension (concluded)

Predictor	Compliers (n = 234)		Non-compliers (n = 82)		Odds ratio (95% CI)	P-value
<i>Fat restriction</i>						
Non-compliant*	26	11.1	27	32.9		
Compliant	208	88.9	55	67.1	3.93 (2.12–7.26)	0.0000
<i>Salt restriction</i>						
Non-compliant*	35	15.0	35	42.7		
Compliant	199	85.0	47	57.3	4.23 (2.40–7.45)	0.0000
<i>Regular exercise</i>						
Non-compliant*	179	76.5	70	85.4		
Compliant	55	23.5	12	14.6	1.79 (0.90–3.55)	0.0940
<i>Mean knowledge scores ± s</i>						
Overall	9.17 ± 2.17		8.93 ± 2.16		1.10 (1.04–1.34)	0.0065
Perception of danger	9.63 ± 1.92		9.60 ± 2.05		1.00 (0.89–1.14)	0.9142
Perception of benefits	18.70 ± 2.26		16.74 ± 2.92		1.33 (1.20–1.48)	0.0000
Perception of susceptibility	3.67 ± 1.36		4.43 ± 1.18		0.64 (0.53–0.79)	0.0000

*Reference category.

s = standard deviation.

n = total number of participants.

CI = confidence interval.

compliers were more likely to maintain or to attempt to achieve an ideal body weight, yet this difference was insignificant (Table 4).

Participants who were complying with pharmacotherapy had significantly better knowledge than non-compliers about the nature of the disease, associated complications and the ideal management plan (mean score 9.17 ± 2.17 versus 8.93 ± 2.16) ($P = 0.0065$). Moreover, compliers knew significantly more about the benefits associated with the adherence to the management plan than non-compliers (mean score 18.70 ± 2.26 versus 16.74 ± 2.92 , $P < 0.001$). Non-compliers were significantly more likely than compliers to perceive themselves susceptible to unfavourable events related to hypertension (4.43 ± 1.18 versus 3.67 ± 1.36 , $P < 0.001$). No significant difference was observed between the two groups in

their perceptions of the danger of their original disease (Table 4).

The participants' demographic characteristics, medical condition, pharmacological management, and knowledge and perceptions of lifestyle modification were modelled as a function of pharmacological compliance. Pharmacological compliance was predicted by achieving a controlled blood pressure, lower likelihood of experiencing drug side effects, better perception of benefits associated with adherence to the management plan, lower perception of susceptibility to hypertension-related complications and restricting dietary fat and salt (Table 5). These factors correctly classified 92.3% of patients who were complying with at least 90% of the prescribed pharmacotherapy as indicated by the model sensitivity.

Discussion

Hypertension is of particular concern among all chronic diseases because it is a major risk factor for cardiovascular mortality [1]. Keeping patients in treatment and ensuring their compliance with a management plan is pivotal.

Wide variation has been reported in the rate of pharmacological compliance with hypertension treatment, ranging from a low of 50% [4,8,12] to a high of 80% [4,12,13]. This has been attributed to the difficulty of comparing across studies in view of the different methodological approaches to setting the level of compliance [4,11] and to monitoring (including pill counts, electronic monitoring, patient self-reports, urine assay and plasma drug concentrations [4,9]). It seems that the observed compliance rate of 74.1% in the present study falls in the upper ranges of compliance. This was based on compliance with 90% of the prescribed drugs and on patient self-reporting. It is generally accepted that admission of non-compliance by patients is reliable but that denial of non-compliance is not entirely accurate [9]. Nonetheless, patient self-reporting of compliance is recommended in clinical practice

because it is simple and has proven to be fairly accurate compared to other methods [4].

Patient's self-reporting of pharmacological compliance has little value if the outcome of interest, i.e., blood pressure control, is not achieved [14]. In this study, compliers were nearly 4 times more likely to achieve controlled blood pressure of $\leq 140/90$ mmHg, a figure that reflects the effect of the drug dose taken the day before [15]. Moreover, it was within the limit of the recommended audit standard of less than 150/90 mmHg [16]. Indeed, a large body of literature has documented the significant association between compliance and controlled blood pressure [4-7,11,17-19] as well as better health outcomes [7] and fewer complications [4,5,8,13].

In our sample, regardless of the duration of hypertension or co-existing health problems, compliers were significantly less likely to report complications affecting target organs. Moreover, achieving controlled blood pressure was found to be an independent predictor of compliance with at least 90% of the prescribed pharmacotherapy. Although the nature of that association could not be determined because of aspects of the study design, physicians should aim

Table 5 Independent predictors of pharmacological compliance

Independent predictors	Coefficient	Adjusted odds ratio	(95% CI)	P-value
Drug side effects	-1.7168	0.18	(0.04-0.75)	0.0185
Controlled blood pressure	0.8887	2.43	(1.34-4.40)	0.0033
Perception of benefits	0.2111	1.23	(1.10-1.38)	0.0003
Perception of susceptibility	-0.3489	0.70	(0.56-0.88)	0.0030
Restriction of dietary salt and fat	0.7640	2.14	(1.16-3.95)	0.0141

CI = confidence interval.

at maximizing the level of compliance at no less than 90% since total compliance cannot be guaranteed [7].

Achieving full compliance requires an understanding of the impediments faced. Several studies [5,15,20] have reported the cost of therapy as a barrier for compliance. This was not always the case for our patients as their medical insurance covered the cost of drugs. This was certainly the reason that almost all were punctual for their prescription refill regardless of their state of compliance.

The barrier to compliance most frequently claimed by our participants was a feeling that their blood pressure was normal and this obviated the need for the recommended dose. The asymptomatic nature of the disease [21] and patients' ability to estimate their own blood pressure [22] are documented barriers to compliance. However, patients should clearly understand that the aim of treatment is to maintain a normal blood pressure and that they should never ignore physician advice or wait until they feel warning signals. They should be aware that once treatment has started it should be continued until they are advised otherwise.

Barriers revealed by the present study and others included drug holidays [19] and forgetfulness [21,23] and these could be addressed. The problem of forgetfulness, for example, could be solved if patients linked the drug dose to their daily habits or rituals.

A combination of classes of antihypertensive drugs with additive effects had been prescribed for some patients to achieve optimal blood pressure [1,16]. Treatment inconvenience [15] and dose schedule [24] have been identified as barriers for compliance. The present and previous studies [4,8,25] observed better adherence with a single daily dose. In this

study neither number of drugs nor dose frequency predicted compliance with treatment but having drug side-effects did predict poor pharmacological compliance, as found in other studies [15,20,21,23]. This underscores the role of the treating physician in checking for drug side-effects and substituting those poorly tolerated by individual patients in order to enhance compliance and achieve the targeted blood pressure.

Risky lifestyles before the start of hypertension symptoms were over-represented among our patients. Nearly one-third were smokers, half were obese, two-thirds were leading a sedentary lifestyle and the majority had an unhealthy diet. Despite this, and the high prevalence of hypertension in Egyptian society, the majority of patients were not concerned about blood pressure monitoring. Generally, blood pressure should be monitored at regular intervals according to the individual's level of risk. Furthermore, healthy lifestyle is a well-recognized cost-effective measure in preventing a wide array of serious health problems.

Perhaps lifestyle modifications should be institutionalized along with pharmacotherapy [1], as even with an acceptable level of compliance, optimal blood pressure cannot be achieved without smoking cessation [1,16,18], maintaining an ideal weight [1,16,17], reducing dietary salt [1,15,17,18] and fat [1,16,18] and exercising regularly [1,14,16]. These recommendations are no longer challenged, but the extent to which doctors' advice is accepted and adopted needs to be determined [14]. Relative to pharmacological compliance, fewer patients comply with lifestyle modification [8]. This has been observed as patients have been instructed about the need and the value of lifestyle modification and still 25%–50% fail to comply with some

aspects of non-pharmacological management.

Some of the participants had a greater preference for a harmful diet than their own well-being. In fact, health should be a valued asset and food should be consumed with the prospects of achieving and maintaining good health. Fodor et al. [14] observed that cost sometimes hampered diet modification. This was encountered in a segment of our participants who failed to comply with diet modification and weight reduction since preparing special dishes incurred extra expenditures. It is not difficult to help patients recognize that such economic barriers could be surmounted by preparing healthy meals for the entire family, as in the long run they are all benefactors. Although all patients can benefit from the favourable effects of regular exercising on blood pressure, the obese will benefit even more from its effect on regulating body weight. Unfortunately, exercising is not a common practice in Egyptian society and the participants who exercised before they became ill generally stopped exercising afterwards because of their poor general condition.

Some of the participants failed to comply with lifestyle modification because of their misconceptions; this was especially true for those who were unable to attempt smoking cessation. The belief that smoking cannot be renounced is totally unfounded. Cessation can be achieved if patients are able to weigh the risks and benefits and are empowered and determined.

Effective implementation of non-pharmacological measures requires physician enthusiasm, knowledge, time and patience [16] as well as skills in behaviour modification [14]. Even those who are highly motivated could be reluctant to advise their patients because of beliefs that their efforts are likely to fail [14]. Our findings provide

evidence of the role of physicians in ensuring patient compliance with non-pharmacological management. In aspects where a large number of patients were instructed, lower numbers were found to resist change. This should certainly boost physician self-confidence about their ability to influence patient behaviour. Physicians should instruct all patients without exception, as a number of our patients lacked knowledge of the danger of some unhealthy habits. Since behaviour is difficult to change, instruction should be repeated and patient education should be part of physician activity in every single patient encounter.

We found evidence that achieving controlled blood pressure was significantly influenced by the extent of pharmacological compliance, which was in turn predicted by some aspects of lifestyle modification, especially smoking cessation and diet modification. Implicit in this finding was that the participants' tendency to comply encompassed all aspects of management. Better adherence was only ensured when the participants developed a clear understanding of the overall management plan. This emphasizes the importance of patient knowledge and beliefs for compliance, as has been previously reported [4,7,8,26]. The participant's perception of the benefits of pharmacological and non-pharmacological treatment of hypertension independently predicted pharmacological compliance. In our sample, those who perceived themselves as susceptible to the illness and its adverse consequences were those who were less likely to comply. This could be a function of patient insight into their own behaviour since susceptibility normally increases as compliance decreases. It could also be that some susceptible patients reached the point of losing faith in the treatment. Whatever the susceptibility might be,

all patients would certainly be rewarded by treatment compliance, either by improving their overall health and minimizing the risk of complications or by stabilizing their condition and preventing further deterioration.

This study demonstrates that patient demographics are poor indicators of compliance and underscored the value of patient education, as previously reported [7]. That the role of the physician extends beyond measuring blood pressure and refilling prescriptions should be greatly emphasized. As educators, physicians can improve the success of the overall management plan set for their patients. Health risk advice should stress the positive aspects of hypertension as a treatable disease, since the perception of the benefits of education was influential whereas perceptions of the dangers of the

disease were not. Special attention should be given to patients who feel excessively vulnerable. Patients must know that physician advice should not be put aside as soon as they feel their blood pressure is under control or that their health is deteriorating. Physicians should seek to increase self-efficacy and personal empowerment. To influence patient behaviour effectively, physicians should have a clear understanding of what patients need to know in order to reach at least 90% compliance with prescribed regimens and lifestyle modifications. It is of utmost importance to discuss the impediments faced by each patient and to work together as partners to surmount them. It is only then that the full benefits of adherence and the effective control of blood pressure will be achieved.

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