

Prevalence of poor glycemic and blood pressure control and pattern of drug use among primary health-care outpatients in Al Ahsa Saudi Arabia

Promise M. Emeka¹,
Ahmed Al Mukalaf¹,
Hussien Al Helal¹,
Tahir M. Khan²,
Mishial A. Almukalf³

¹Department of Pharmaceutical Science, College of Clinical Pharmacy, King Faisal University, Hofuf, Kingdom of Saudi Arabia, ²Department of Clinical Pharmacy, School of Pharmacy, Monash University, Malaysia, ³Department of Public Health, Reference Laboratory, Health Admin Center Khobar, Kingdom of Saudi Arabia

Address for correspondence:

Promise M. Emeka, Department of Pharmaceutical Science, College of Clinical Pharmacy, King Faisal University, Hofuf, Kingdom of Saudi Arabia.
Phone: 00966-03-5899821.
E-mail: pemeka@kfu.edu.sa

WEBSITE: ijhs.org.sa

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ABSTRACT

Objectives: To assess drug use pattern and the effect on glycemic and blood pressure (BP) control in type 2 diabetes mellitus (T2DM) and hypertensive patients. Furthermore, to evaluate the duration of drug use and antecedence in diagnosis.

Methodology: A cross-sectional study design, comprising interview/questionnaire targeting outpatients attending primary health centers in Al Ahsa was adopted. During the interview, their fasting blood glucose, weight, and height were measured, along with their BP. Time and duration of drug use were recorded. The history, sociodemographic data and the presence of any other disease conditions were also documented.

Results: The highest number of uncontrolled BP and poor glycemic control was among the age group of 45 and 49 years. Significant number of the patients (92.9%) had body mass index >30 kg/m². The prevalence of developing hypertension before T2DM among participants was 59.9%. A significant number (84%) had uncontrolled hypertension, and 67.3% had uncontrolled T2DM. Drug use pattern revealed single or combinations according to clinical guidelines initially but did not follow through in meeting targets. Majority received angiotensin converting enzyme inhibitors, amlodipine or atenolol for BP control and metformin for T2DM. Patients diagnosed between 1 and 5 years displayed significant poor glycemic and BP control. Significantly, most patients appeared to have been on same prescriptions for a longer time without review.

Conclusion: Poor glycemic and BP controls observed in this study could be due to deficient treatment strategy among others. Patients were, however, not adequately managed in line with prescribed clinical guidelines.

Keywords: Body mass index, blood pressure control, comorbidity, drug use, glycemic control, type 2 diabetes mellitus

Introduction

Increase in wealth breeds comfort living which brings about lifestyle changes and diseases associated with it. This ultimately leads to increased prevalence of lifestyle-related diseases such as type 2 diabetes mellitus (T2DM) and hypertension. The Eastern Mediterranean Region has experienced a rapid increase in the incidence of T2DM, and on its heels is hypertension.¹⁻³ T2DM is reported to be the fourth primary cause of death in the Mediterranean region, with an estimated 22 million people with the disease out of a population of 290 million adults.³ The coexistence of these two diseases is known to exert enormous financial burden on health-care budget all over the world.⁴ Several studies have shown that majority of patients with diabetes also end up developing hypertension.^{5,6} Complications such as macrovascular and

microvascular disorders share common mechanism and do overlap in diabetes and hypertension. Available literature shows high blood pressure (BP) to be associated with insulin resistance and could be seen as a risk factor for diabetes mellitus.^{5,6} Furthermore, complications induced by coexistence of diabetes, hypertension, and obesity could precipitate serious conditions that will reduce life expectancy. The associated impact of this comorbidity on the health and quality of individual lives will be enormous both on the cost of management as well as in the outcome. A previous study, that looked at the relationship between having these diseases and the health-related quality of life, showed that individuals who are diabetic, hypertensive, and obese registered a poor outcome on all the scales compared with those without the three risk factors.⁷ Research has shown that the risk factors can also interfere with each other and subsequently effect their

eventual management. Examples are the effects of obesity and hypertension on the treatment of diabetes. Resistance to insulin-mediated glucose disposal was reported to increase in the presence of obesity and high BP.⁸ In addition, Maheux *et al.*⁸ reported that the high plasma glucose responses and steady state plasma glucose concentrations were found in obese subjects with both high BP and T2DM. Control of BP has been shown to be beneficial on these complications, with studies indicating that each 10-mmHg reduction in systolic blood pressure (SBP) leads to a drop in diabetes-related mortality by 15%, diabetes-related complications by 12%, and myocardial infarctions by 11%.⁹ On the other hand, studies have indicated that the negative effects of diabetes, hypertension, and obesity together are additive.¹⁰⁻¹²

Therefore, glycemic and BP control are very important determinants of cardiovascular outcome in obese diabetic hypertensive patients. Consequently, having multiple risk factors presents a complex outlook and can lead to difficulties in the managing both disease states.¹³ Achieving target BP and fasting blood glucose (FBG) will be a daunting task without the cooperation of the patients. An attempt can, however, be made at following prescribed clinical guidelines, which can also be predicated on patients' compliance to lifestyle modifications. To control BP in diabetic patients, clinical guidelines prescribe a target of <140 for SBP and <90 for diastolic BP (DBP).¹⁴⁻¹⁶ A FBG of <126 mg/dl is also defined as a target for diabetic patients.^{2,10} However, patients are to be continuously assessed with the adjustment of drugs as recommended in cases where the targets are not met initially. Moreover, adhering to clinical guidelines in prescribing medications for T2DM and hypertension have been shown to improve clinical outcome.^{17,18} This study was conducted to evaluate the medication profile of T2DM hypertensive outpatients attending various primary health centers within Al Ahsa. Our objectives were to examine their drug use pattern and the consequent outcome on glycemic and BP control, and also, to evaluate the duration of drug use and the history of diagnosis, including the presence of any other disease conditions.

Materials and Methods

Materials

Materials used for the study were, Accu-Check Active product of Roche-Diagnostics GmbH Germany and Geratherm desktop BP monitor + Arrhythmia Detection apparatus (product of Geratherm Medical Diagnostic System, Germany). They were supplied by Deanship of Scientific Research (DSR) King Faisal University for this project.

Methods

A cross-sectional study using structured interview/questionnaire was conducted to assess drug use pattern among outpatients attending different primary health centers in Al Ahsa. The questionnaire used for the interview was tested among

15 patients attending the university polyclinic for suitability and response. After the pilot study, the most common symptoms experienced by patients were included in the questionnaire. Participation was voluntary with 156 patients agreeing to take part in the survey. They gave their consent willingly to participate after the purpose of the study, and its intended outcomes had been explained to them. The consent form was part of the questionnaire, and only patients who agreed to participate and signed were included in the study. Unsigned questionnaire was discarded.

Inclusion criteria

1. Patients living with both T2DM and hypertension.
2. Must be under regular anti-diabetic medication.
3. Diagnosed for at least 1 year and must be living in Al Ahsa Saudi Arabia.

Exclusion criteria

1. Visitors who do not reside in Al Ahsa.
2. Patients who had just been diagnosed (3 months to 1 year).
3. Pregnant women and those using a combination of herbal medication.

Interviews were conducted face to face with the questionnaire forms filled out by the authors. The questionnaire which was in English language was also translated into Arabic language to ensure that all patients were able to understand the questions before answering them. Confidentiality of all personal information collected was assured. During the interview, patients gave information regarding the history of disease, time of diagnosis, coexistence of other chronic illness and when, drug use and how long they have been on the medication, awareness of the disease, adherence to medications and counseling. FBG level was ascertained using Accu-Check Active blood sugar measuring device, while BP measurement was done with the aid of Geratherm desktop BP monitor. BP was measured three times and the average taken. Body weights and height measurements were also performed during the interview. Uncontrolled hypertension is indicated with SBP >140 mm Hg and DBP of >90 mm Hg, in accordance with Eighth Joint National Committee (JNC8),¹⁶ while uncontrolled T2DM was defined as FBG level of >126 mg/dl all according to clinical guidelines.¹⁰ Hemoglobin A1c was, however, not determined due to lack of funding. Body mass index (BMI) was calculated as a ratio of weight (kg) to height (m²). Patients were defined as obese if BMI >30 kg/m² in accordance with the World Health Organization (WHO) criteria.

Data analysis

Descriptive statistics of data collected were expressed as mean \pm standard deviation using Excel spreadsheet, which were then transferred to IBM SPSS Statistics 19 software for further analysis. Statistical significance was determined using Student's *t*-test, Fisher's test, and Mann-Whitney *U*-test to

compare group differences. Statistical significance was denoted as $P < 0.05$.

Results

The sociodemographic data in Table 1 showed the age and gender distribution, history of diagnosis and drugs taken. There were 6.4% female and 93.6% male who participated in the study, with a mean age of 45.23 ± 7.63 . All were diabetic hypertensive patients. The low number in female participation is largely due to cultural issues in this region. In addition, the age group of 45-49 participated more than any other age group in this study.

Analysis of age group data among the study population revealed a progressive rise as the age increase. This surge appeared to peak between the ages of 45-49 years for diabetic hypertensive patients as shown on Figure 1. Again, this trend appeared to represent the number of participants in each group. However,

Table 1: Sociodemographics of the respondents

Variable	n=156 (%)	
Age (years)		
<29	1 (0.6)	
30-34	15 (9.6)	
35-39	21 (13.5)	
40-44	31 (19.9)	
45-49	39 (25)	
50-54	29 (18.6)	
55>	20 (12.8)	
Gender		
Male	146 (93.6)	
Female	10 (6.4)	
History of diagnosis (years)	T2 diabetes mellitus	Hypertension
1-5	78 (50)	75 (48)
6-10	52 (33.3)	46 (29)
11-15	17 (10.9)	25 (16)
16>	9 (5.8)	11 (7.0)
Drug use		
Type 2 diabetes mellitus		
Metformin	71 (45.5)	
Metformin+Acarbose	6 (3.9)	
Metformin+Glipizide	37 (23.7)	
Insulin	19 (12.2)	
Undisclosed	23 (14.7)	
Hypertension		
ACEIs	71 (45.5)	
ACEIs+Atenolol	15 (9.6)	
Atenolol	29 (18.6)	
Amlodipine	17 (10.9)	
Undisclosed	24 (15.4)	

ACEIs: Angiotensin converting enzyme inhibitors

age group 30-34 displayed a better control of BP as compared to others. The obtained results also showed that controlled hypertensive patients did not exhibition any consistent trend with respect to age group compared to controlled diabetic patients. The age group of 45-49 was seen to display a better glycemic control when compared to other age groups but with a poor BP control. Interestingly, this particular age group represented 25% of the study population and with the highest comorbid condition.

A significant number of the patients (92.9%) were obese with BMI > 30. Only 3.9% of the study group was within the WHO range of normal BMI for diabetic and hypertensive patients, and the results are presented in Figure 2. This was determined from their weight and height taken during the interview. It represented a significant number ($P < 0.05$) compared to both overweight and normal patients who participated in the study.

The majority of patients were found to have been diagnosed with hypertension before developing diabetes. This represented 59.9% of the patients who participated in the study which is statistically significant ($P < 0.05$), compared with those who had diabetes first (22.4%). However, patients who were diagnosed with both diseases at the same time represented only 17.7% (Figure 3). It suggests that obesity accelerated the process of comorbidity.

Results showed that despite being on medications, glycemic, and BP controls were generally poor. Controlled T2DM - hypertension was only 26.6% with a significant number (73.4%) uncontrolled, although uncontrolled hypertension was higher (84.6%) when compared with uncontrolled diabetes (62.2%). In all cases, uncontrolled T2DM hypertension was significantly higher ($P < 0.05$) than controlled. In general, patients who did not disclose their drug use contributed to the numbers of uncontrolled FBG and BP levels (Figure 4).

Drug use pattern revealed the use of angiotensin converting enzyme inhibitors (ACEIs), calcium channel blocker amlodipine and β -blocker atenolol. Some patients were prescribed a combination of ACEIs with atenolol, whereas others were given single medication of ACEIs, amlodipine or atenolol (Table 2). Obtained results also showed that ACEIs (ramipril, lisinopril, and enalapril) were the most singly used medication compared to other antihypertensive drugs followed by atenolol. We observed that in most of the cases, the number of uncontrolled cases was significantly higher than controlled cases. Calculated P value showed that there were significant differences between controlled and uncontrolled BP in the hypertensive patients at $P < 0.05$. In addition, those who did not disclose their medication had a significant number of uncontrolled BP.

On the other hand, drugs used to control T2DM among the patients included metformin either alone or in combination with glipizide or acarbose and insulin (Table 2). Majority of

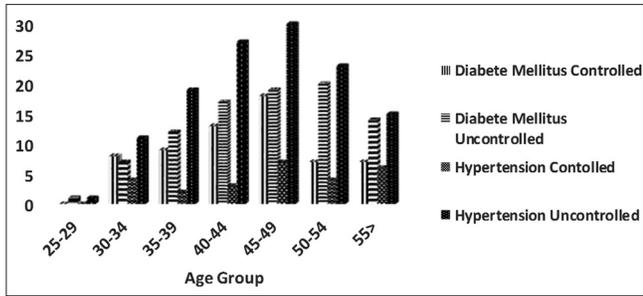


Figure 1: Age group distribution of controlled and uncontrolled diabetic and hypertensive patients attending primary health care center in Al Ahsa

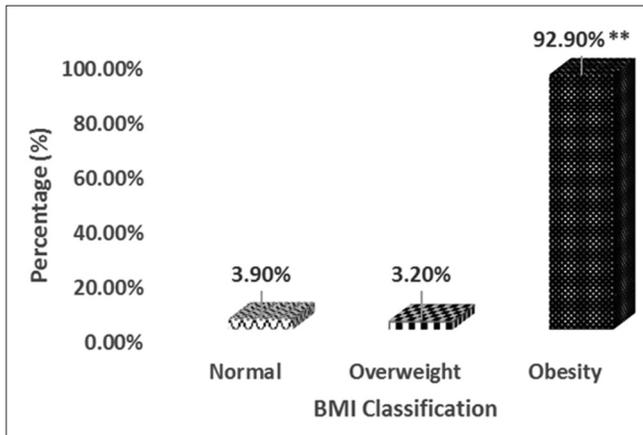


Figure 2: Body mass index distribution among the study population (** $P < 0.01$)

the patients who were using metformin exhibited the highest number of uncontrolled diabetes ($P < 0.05$). This trend was also observed among those using insulin alone. Some of the patients did not disclose what medication they were using. However, it was noted that patients who had a combination of metformin plus glipizide or acarbose had a better glycemic control compared to others.

Analysis of history of diagnosis data revealed a tendency that appeared to show recently diagnosed patients with poor glycemic and BP control. This trend is so because the number of patients diagnosed with both T2DM and/or hypertension in the past 16 years and more, were less in number compared to those between 1 and 5 years. All results displayed poor glycemic and BP control which were statistically significant compared with controlled patients ($P < 0.05$) (Table 3).

The results on the duration of drug use over the years among hypertensive patients are shown in Table 4. This data indicated that patients stayed too long using same medication with poor control of BP without review. For those who had taken same medication for 1 year, we observed that majority were not controlled. The trend can be clearly seen with patients taking ACEIs even for up to 4 years. In a similar fashion, diabetic patients appeared to have been left on the same medications for too long without review.

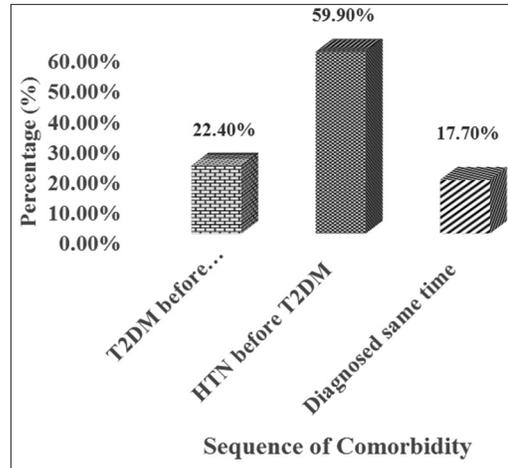


Figure 3: Pattern of diagnosis for both type 2 diabetes mellitus and hypertensive patients

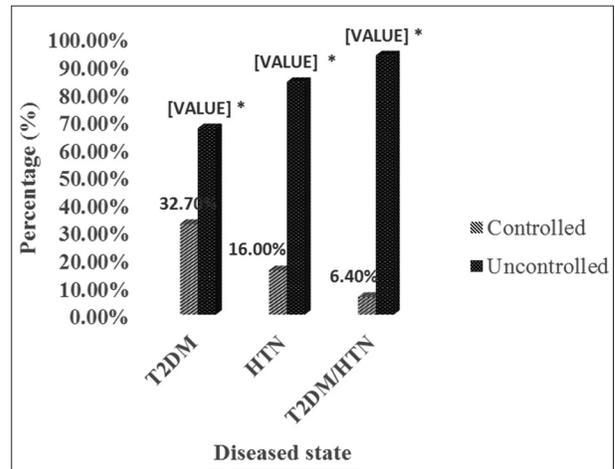


Figure 4: Percentage of both controlled and uncontrolled type 2 diabetes mellitus and hypertensive patients on medications (* $P < 0.05$)

This is also shown by the number of controlled/uncontrolled FBG levels among patients taking same medications over the years. Results, however, revealed that metformin/glipizide combination appeared to have a better outcome compared to other drugs prescribed (Table 5).

Discussion

Age has always been a factor in developing T2DM or hypertension according to Xie *et al.*¹⁹ and Poulsen *et al.*²⁰ We found that age ranges of 40-54 years were mostly affected by T2DM - hypertension in the population studied. This finding was consistent with the study of Channanath *et al.*²¹ in the Kuwait population who reported a mean of 48.63 and 50 years for T2DM and hypertension, respectively. This might explain why the American Diabetes Association (ADA)²² stipulated screening for T2DM from the age 45 as most of the patient might not be aware that they carry the disease. However, in this study, all the age groups had variable effects on glycemic and BP control.

A significant percentage of the participants in this investigation were obese, hence with enhanced insulin resistance caused by comorbidity, prognosis will be definitely poor. The effective therapeutic management of patients with T2DM and hypertension lies in multimedia drug treatment. However, this can be a complex task to undertake in the presence of obesity. Control of patients' weight will be an important factor in meeting targeted FBG and BP. Turner *et al.*²³ observed that obesity control measures in general practice were not consistent with guidelines. In Australia, 62% of primary health-care outpatients were found to be obese.²⁴ Therefore, lack of better strategy to manage obesity will further compound the management of these patients. Most of the patients in this investigation had hypertension before being diagnosed with T2DM. This finding is consistent with that of Liu *et al.*²⁵ who reported a high prevalence of T2DM among outpatients with hypertension in China. In a similar study, Lundgren *et al.*²⁶ reported that 81% of the patients attending health centers had developed hypertension before T2DM. This would, therefore, indicate that the prevalence of hypertension was higher among those diagnosed with diabetes as earlier stipulated by Gillespie and Hurvitz.²⁷ Furthermore, Cappuccio *et al.*²⁸ reported in

a comparable fashion that ethnic minority in South London showed the same trend as those seen in this study. As regards medication, an Atherosclerosis Risk in Communities Study indicated that there is an increased risk of developing diabetes with the use of β -blockers.²⁹ The prolong use of thiazide diuretics and beta-blockers has been reported to lead to an increase in blood glucose levels.³⁰ Therefore, hypertension could be described as a strong predictor of T2DM, according to Kim *et al.*³¹

Despite the fact that the participants in this study kept regular clinic appointments and claim to use their medications, glycemic, and BP control were generally poor. The control of BP in patients with T2DM has been shown to significantly reduce diabetes-related mortality as well as other complications associated with comorbidity.^{32,33} It is, therefore, beneficial to institute adequate BP control to reduce complications and improve the quality of life.^{6,34}

In this study, the use of single medications in managing either T2DM or hypertension did not appear to meet the target FBG or BP or both. In most cases, FBG and BP were observed to be twice the suggested level by ADA or JNC8.^{15,22} Clinical guidelines are the meeting point between research evidence and clinical management that can advance patient's outcomes. Guideline suggests that if a drug does not achieve the target over 3 months in patients with T2DM, a second oral agent or insulin should be added.³⁵ It went on to say that, insulin should be indicated eventually. This was not the case for majority of the patients in this investigation. A significant number stayed on one medication for longer than 1 year without review. Furthermore, according to JNC8 guideline^{15,16} should the target for patients with BP >140/90 not been achieved, with a single medication, 1-2 additional medication should be added.¹⁶ Following treatment guidelines for patients with comorbid states are a recommendation many studies have suggested to slow the progression of associated complications.³⁶

A significant number of uncontrolled BP observed in this study could also be associated with equally high BMI exhibited by participants. Another factor might be as a result of the use of other non-prescribed medications not disclosed which could subsequently affect medication efficacy and interfere with glycemic and BP control.

Table 2: Drug use pattern in controlled versus uncontrolled T2DM and in HTN

Drugs use	No. of controlled (%)	No. uncontrolled (%)	P value
HTN drug treatment			
ACEIs	11 (15.5)	60 (84.5)	0.0001*
ACEIs plus atenolol	0 (0)	15 (100)	0.0001*
Atenolol	3 (10.3)	26 (89.7)	0.0001*
CCB	4 (23.5)	13 (76.5)	0.0001*
Not disclosed	6 (25)	18 (75)	0.0238*
T2DM drug treatment			
Metformin	28 (39.4)	43 (60.6)	0.0118*
Metformin plus Glipizide	22 (59.5)	15 (40.5)	0.1036
Metformin plus Acarbose	3 (50)	3 (50)	1.0
Insulin	4 (21.1)	15 (78.9)	0.0004*
Not disclosed	2 (8.7)	21 (91.3)	0.0001*

* $P < 0.05$. T2DM: Type 2 diabetes mellitus, HTN: Hypertension, ACEIs: Angiotensin converting enzyme inhibitors, CCB: Calcium channel blocker

Table 3: Number of patients having controlled and uncontrolled diabetes and hypertension according to history of diagnosis

Period of diagnosis	T2 diabetes mellitus			Hypertension		
	Controlled	Uncontrolled	P value	Controlled	Uncontrolled	P value
1-5 years	27	51	0.00012*	9	66	0*
6-10 years	15	37	0*	5	41	0*
11-15 years	7	10	0.30302	4	20	0*
16 and above	1	8	0.00096*	3	8	0.0

*Significant at $P < 0.05$

Table 4: Number of years on same medication with controlled or uncontrolled BP in hypertensive patients

Period (years)	ACEIs		ACEIs/atenolol		Atenolol		CCB (amlodipine)	
	C	Uc	C	Uc	C	Uc	C	Uc
1	3	14	0	3	0	7	2	6
2	3	19	0	10	1	7	0	2
3	1	12	0	0	0	7	1	3
>4	4	15	0	2	2	5	1	2

C: Controlled, Uc: Uncontrolled, ACEIs: Angiotensin converting enzyme inhibitors, CCB: Calcium channel blocker, BP: Blood pressure

Table 5: Number of years on same medication with controlled or uncontrolled fasting blood glucose in type 2 diabetes mellitus patients

Period (years)	Metformin		Metformin/Acarbose		Metformin/Glipizide		Insulin	
	C	Uc	C	Uc	C	Uc	C	Uc
1	12	16	1	1	8	4	0	3
2	5	8	0	0	7	6	2	3
3	6	10	1	1	4	2	0	6
>4	5	9	1	1	3	3	2	7

C: Controlled, Uc: Uncontrolled

Conclusion

Poor glycemic and BP controls observed in this study could be due to deficient treatment strategy by all concerned. In most cases, treatment guidelines were not duly observed or followed accordingly. Since there is no threshold for the risk of comorbidity (diabetes-hypertension) in patients, we, therefore, advise continuous assessment to meet the targeted FBG and BP levels by medication adjustment. There may be some elements of nonadherence to medications and counseling by the patients, in which they were not willing to wholeheartedly disclose. Nevertheless, difficulties in managing lifestyle changes in an affluent society might also be a contributory factor.

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