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RESEARCH ARTICLE CLINICAL PHARMACY AND PHARMACOLOGY

Prevalence of Hypertension and its Associated Risk Factors in Libyan Type 2 Diabetic Patients

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ABSTRACT

Hypertension is a major risk factor of cardiovascular disease that is associated with complications in type 2 diabetic patients, which is the most prevalent cause of morbidity and mortality in diabetic patients. A cross-sectional study was carried out on 460 type diabetic patients in diabetic center Al-Jabal Al-Akhdar in Al-Bayda city, Libya from April to August 2025. The main objective of our study was to assess the prevalence of hypertension and its associated factors in type 2 diabetic patients. Data: a structured questionnaire included demographic and clinical information, duration of diabetes, glycemic control according to HbA1C measurements. Data was analyzed using SPSS software version 26.0. Total of 460 type2 diabetic patients we found the prevalence of hypertension was 228 (49.6%). It was more prevalent in women than in men (62.7% and 37.3% respectively), uncontrolled blooFd glucose (75.9%) and positively associated with age (P=0.000), education level (P=0.000), smoking (P=0.013), family history (P=0.000) and duration of diabetes (P=0.021). The study showed the prevalence of hypertension in type2 diabetic patients. Nearly half of the participants. Health providers must collaborate to reduce this complication by focusing on educating the patient and family about the disease and its complications as well as medications compliance.

انتشار ارتفاع ضغط الدم وعوامل الخطر المرتبطة به لدى مرضى السكري من النوع الثاني في ليبيا

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الكلمات المفتاحية
الضغط
العوامل المرتبطة
السكري النوع الثاني
ليبيا

الملخص

يُعد ارتفاع ضغط الدم عامل خطر رئيسي لأمراض القلب والأوعية الدموية، ويرتبط بمضاعفات لدى مرضى السكري من النوع الثاني، وهو السبب الأكثر شيوعًا للوفيات بين مرضى السكري. أُجريت دراسة مقطعية على 460 مريضًا بالسكري من النوع الثاني في مركز السكري بالجبل الأخضر في مدينة البيضاء، ليبيا، خلال الفترة من أبريل إلى أغسطس 2025. كان الهدف الرئيسي من دراستنا هو تقييم مدى انتشار ارتفاع ضغط الدم والعوامل المرتبطة به لدى مرضى السكري من النوع الثاني. استُخدم استبيان مُنظّم شمل معلومات ديموغرافية وسريرية، ومدة الإصابة بالسكري، ومستوى السكر في الدم وفقًا لقياسات الهيموجلوبين السكري (HbA1c). تم تحليل البيانات باستخدام برنامج SPSS الإصدار 26.0. من بين 460 مريضًا بالسكري من النوع الثاني، وجدنا أن معدل انتشار ارتفاع ضغط الدم بلغ 228 (49.6%). كان ارتفاع ضغط الدم أكثر شيوعًا بين النساء منه بين الرجال (62.7% و37.3% على التوالي)، وكذلك ارتفاع مستوى السكر في الدم غير المنضبط (75.9%)، وارتبط إيجابيًا بالعمر (P=0.000)، والمستوى التعليمي (P=0.000)، والتدخين (P=0.013)، والتاريخ العائلي (P=0.000)، ومدة الإصابة بداء السكري (P=0.021). أظهرت الدراسة انتشار ارتفاع ضغط الدم بين مرضى السكري من النوع الثاني، حيث عانى منه ما يقارب نصف المشاركين. يجب على مقدمي الرعاية الصحية التعاون للحد من هذه المضاعفات من خلال التركيز على تثقيف المريض وأسرته حول المرض ومضاعفاته، بالإضافة إلى الالتزام بتناول الأدوية.

Introduction

Diabetes mellitus (DM) is a chronic metabolic disorder that represents the seventh cause of death according to WHO by 2030 [1]. 150 million people world-wide was affected by type2 diabetes [2]. Cardiovascular disease is associated with type 2 diabetic patients that were affected by morbidity and progression of premature death [3]. One of these CV diseases was hypertension, which was considered the most prevalent cause of death in developed as well as developing countries [4] and is said to be twice as prevalent in diabetics than in non-diabetic individuals. Uncontrolled hypertension affects many organs such as the brain, heart, and kidney, leading to heart attack, stroke, vision loss and peripheral arterial disease [5].

A study on DM patients showed that the coexistence of hypertension in Diabetes mellitus is attributed to the risk of death and cardiovascular events by 44% and 41%, respectively, as compared to 7% and 9% of risks in people with diabetes alone [6]. Evidence indicates vascular

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alterations caused by chronic hyperglycemia, along with insulin resistance and hyperinsulinemia. Significantly contribute to the development and progression of hypertension in diabetic patients.

These changes include endothelial dysfunction, proliferation of vascular smooth muscle cells, increased vascular tone, and a disrupted balance between vasodilators and vasoconstrictors [7]. A study conducted from 2013-2022 to evaluate the cardiovascular disease in type2 diabetic patients indicated that Libyan type2 diabetic patients have high CV risk he factors [8]. Knowing the prevalence of hypertension in different regions and countries around the world is an important step in designing suitable policies to control hypertension in diabetic patients.

For this reason, our study aimed to assess the prevalence of hypertension and its associated factors in type2 diabetic patients.

Methodology

This is a cross-sectional study of four hundred and sixty patients (460 patients) with type 2 diabetic patients at Diabetes Center Al-Jabal Al-Akhdar in Al-Bayda city from April to August 2025 to assess the prevalence of hypertension and its associated factors in type2 diabetic patients.

Questionnaire

Data obtained from participants included age, gender, educational level, smoking, physical activity, family history of (DM-HTN), duration of diabetes.

Glycemic control by measuring HbA1C, according to the American Diabetic Association. Glycemic control was categorized as controlled if HbA1C was less than 7% and uncontrolled if HbA1C was more than 7%.

BMI by measuring weight in kilograms (Kg) and divided by square of height in meters. BMI was categorized as normal at 18.5-24.9 kg/m², overweight of 25-29.9 kg/m², and obesity of ≥ 30 kg/m². Hypertension was diagnosed using a mercury sphygmomanometer with a systolic blood pressure > 140 mmHg or a diastolic blood pressure of >90 mmHg on at least two occasions, or if the patient was on antihypertensive drugs. Type1 diabetic patients, pregnant women and the patients who did not want to be participate in this study were excluded. This study was conducted after approval from the faculty of pharmacy at Omar Al-Mukhtar University. Informed consent form was taken from all participants

Statistical analysis

Data was analyzed by using the Statistical Package for Social Sciences SPSS version 26.0 and were presented by frequency and percentage by using descriptive statistics. Correlation between different variables was tested by Chi-square test. A value less than 0.05 was considered significant.

Result

Table 1, shows the demographic and clinical characteristics of the sample. A total of 460 participants in the age group (35-44) (45-55y) (56-66) and ≥67y was 5.4%, 22%, 37.4% and 35.2% respectively. 187 male (40.7%) and 273 female (59.3%). The duration of diabetes was 74.6% above 5 years. 77% non-smoker due to the minority of the male in this study, but this percentage indicates that most male type2 diabetic patients were smokers.

From 460 patients in this study 228 with diabetes had hypertension, giving a prevalence rate of 49.6%, as shown in Table 2.

Prevalence of hypertension among participants of the sample

Table 1: Demographic and clinical characteristic of Type2 diabetic participants(n=460)

Variable	Frequency	Percentage
Age		
35-44	25	5.4%
45-55	101	22%
56-66	172	37.4%
≥67y	162	35.2%
Gender		
Male	187	40.7%
Female	273	59.3%
Educational level		
Illiterate	97	21.1%
Primary	116	25.2%
Secondary	127	27.6%
Graduate	120	26.1%
BMI		
Normal	68	14.8%
Overweight	191	41.5%
Obese	201	43.7%
Smoking		
Yes	106	23%
No	354	77%
Physical activity		
Yes	74	16.1%
No	386	83.9%
Duration of diabetes		
Less than 5 years	117	25.4%
≥5y	343	74.6%
Family history		
DM	259	56.3%
HTN	14	3%
Both	109	23.7%
No FH	78	17%
Glycemic control		
Controlled	107	23.3%
Uncontrolled	353	76.7%

Table 2: Prevalence of hypertension among participants of the sample

Hypertension	Frequency	Percentage
Yes	228	49.6%
No	232	50.4%

Table 3. shows the factors associated with the prevalence of hypertension where found increase in the number of hypertensive cases with advancing age, with the highest frequency observed in the ≥67 years group (105 cases), followed by the 56–66 years group (76 cases). In contrast, the 35–44 years group had the lowest count (4 cases), as illustrated in Fig. 1.

The Chi-square test revealed a statistically significant association between age and hypertension ($\chi^2 = 30.303$, df = 3, P = 0.000). This indicates that older diabetic patients are significantly more likely to have hypertension.

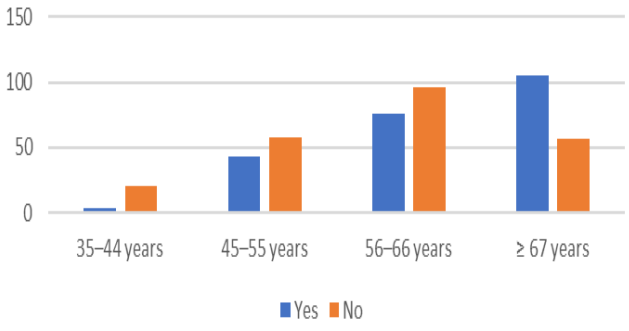

Figure 1: Association between age groups and hypertension (HTN) among diabetic patients

Table 3: Association Between variables and Hypertension (HTN) Among type2 Diabetic Patients

Variable	HTN	P value
Age		
35-44	4 (1.8%)	
45-55	43(18.9%)	**0.000***
56-66	76(33.3%)	
≥67y	105(46.0%)	
Gender		
Male	85(37.3%)	**0.086**
Female	143(62.7%)	
Educational level		
Illiterate	66(28.9%)	
Primary	57 (25.0%)	**0.000***
Secondary	58(25.5%)	
Graduate	47(20.6%)	
BMI		
Normal	30(13.2%)	
Overweight	95(41.6%)	**0.596**
Obese	103(45.2%)	
Smoking		
Yes	42(18.4%)	**0.013***
No	186(81.6%)	
Physical activity		
Yes	38(16.7%)	**0.417**
No	190(83.3%)	
Duration of diabetes		
Less than 5y	48(21.1%)	
≥ 5y	180(78.9%)	**0.021***
Family history		
DM	80(35.1%)	
HTN	9(3.9%)	**0.000***
Both	102(44.8%)	
No FH	37(16.2%)	
Glycemic control		
Controlled	55(24.1%)	**0.373**
Uncontrolled	173(75.9%)	

* p value less than 0.05 means a statistically significant.

Hypertension was observed in 85 males compared to 143 females. While females had a slightly higher frequency of hypertension, the Chi-square test result ($\chi^2 = 2.130$, df = 1, P = 0.086) indicates that this association was not statistically significant.The highest frequency of hypertension was observed among obese participants (103 cases,45.2%), followed by overweight participants (95 cases, 41.6%), while the lowest frequency was recorded among those with normal BMI (30 cases, 13.2%). The Chi-square test revealed no statistically significant association between BMI and hypertension ($\chi^2 = 1.036$, df = 2, P = 0.596).

Hypertension prevalence varied significantly across education levels (Fig. 2). The highest frequency of hypertension was observed among illiterate participants (66 cases), whereas graduates had the lowest count (47 cases). The Chi-square test revealed a statistically significant association between education level and hypertension ($\chi^2 = 19.216$, df = 3, P = 0.000).

The prevalence of hypertension was notably higher among non-smokers (186 cases) compared to smokers (42 cases). The Chi-square test revealed a statistically significant association between smoking and hypertension ($\chi^2 = 5.447$, df = 1, P = 0.013).

The relationship between hypertension (HTN) and physical activity, hypertension was more prevalent among participants who reported no physical activity (190 cases, 83.3%) compared to those who engaged in physical activity (38 cases, 16.7%). However, the Chi-square test indicated no statistically significant association between physical activity and hypertension ($\chi^2 = 0.113$, df = 1, P = 0.417).

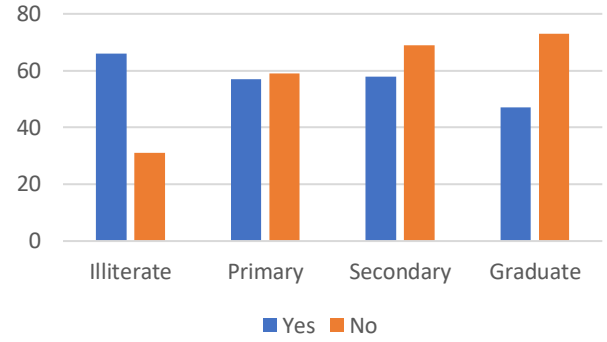

Figure 2: Association between education level and hypertension (HTN) among diabetic patients

Also, shows a strong association between family history and hypertension among diabetic patients. Hypertension was most prevalent among those with a combined family history of diabetes and hypertension (102 hypertensive), followed by those with a family history of diabetes alone (80 hypertensive). Participants with no family history had 37 hypertensive patients, while those with a family history of hypertension alone showed 9 hypertensive cases, as shown in Fig. 3. The Chi-square test result ($\chi^2 = 121.9$, df = 3, P = 0.000) confirms a highly significant association, indicating that a positive family history, particularly for both diabetes and hypertension, is strongly linked to a higher prevalence of hypertension among diabetic patients.

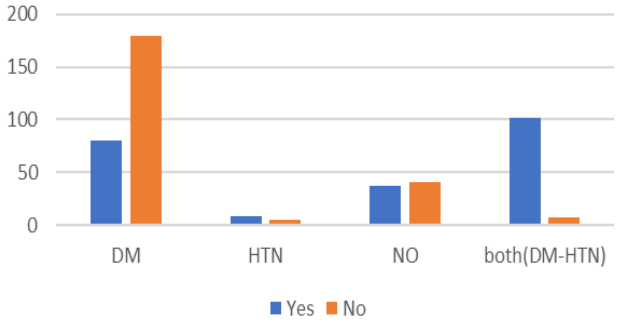

Figure 3: Association between family history and hypertension (HTN) among diabetic patients

Hypertension was more prevalent among patients with a diabetes duration of ≥ 5 years (180 hypertensive vs. 163 non-hypertensive) compared to those with a duration of less than 5 years (48 hypertensive vs. 69 non-hypertensive). The Chi-square test result ($\chi^2 = 4.577$, df = 1, P = 0.021) indicates a statistically significant association between diabetes duration and hypertension as shown in Fig. 4.

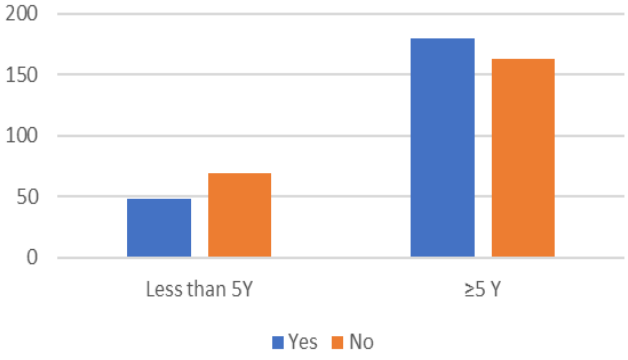

Figure 4: Association between hypertension and duration of Type 2 DM

Hypertension was observed in 55 patients with controlled HbA1c and in 173 patients with uncontrolled HbA1c. However, the Chi-square test result ($\chi^2 = 0.188$, df = 1, P = 0.373) indicates no statistically significant association between HbA1c control and hypertension among diabetic patients.

Discussion

Hypertension is a common problem in type2 diabetic patients. Where the prevalence of hypertension is twice in diabetic patients compared to non-diabetic individuals. Diabetic patients with hypertension have a risk for accelerated progression of both microvascular (retinopathy, nephropathy, and neuropathy) and macrovascular (atherosclerotic) complications. The majority of deaths in patients with type 2 diabetes are caused by macrovascular disease [9].

Our study was designed to assess the prevalence of hypertension in type2 diabetic patients. We found the prevalence of hypertension in nearly half of participants in this study (49.6%, n=228) compared to other studies from different regions, where in Arab countries found the prevalence of hypertension in diabetic patients was 64.5% in Qatar [10] and 72.4% in Jordanian diabetic patients [11]. While moderate in other countries, 44%, 53% and 38% in Omani diabetic [12], Saudi diabetic [13] and Bahraini diabetic [14] respectively.

In other populations, the prevalence varied from high, as in Italy (74.4%) [15] and Spanish (73%) [16], And the medium rate of hypertension among diabetic patients is 32% and 39% in Turkish [17] and Taiwanese [18] patients. The difference in rates in each country may be related to different methods of data collection, population characteristics or ethnic variations [19].

Our study also reported factors associated with the prevalence of hypertension in type2 diabetic patients. Our results showed that patients ≥67 years have a high frequency with significant association (P=0.000), similar to other studies [20] where the older age has been linked with progression of disease and its complications that are related to lack of adherence to diabetic medications or lack of care.

According to gender, the prevalence of hypertension in females (n=143) is different from males (n=85). This is a difference and may not represent the actual difference in hypertension distribution in diabetic patients in the community, but our data reported gender was not significantly associated with hypertension among diabetic patients. Thus, both male and female diabetic patients appear to have comparable risk levels for hypertension.

Studies suggest that sex hormone changes play a pivotal role in the pathophysiology of hypertension in postmenopausal women. Estrogens influence the vascular system by inducing vasodilatation, inhibiting vascular remodeling processes, and modulating the renin-angiotensin aldosterone system and the sympathetic system. This leads to a protective effect on arterial stiffness during reproductive age that is dramatically reversed after menopause [21,22].

The prevalence of HTN is associated with educational level, where the highest frequency of hypertension was observed among illiterate participants (28.9%), while 25% in primary education, which was similar to another study that reported that the risk of hypertension in patients with education at primary level and below compared to the patients with education at middle school or above [23]. Poor education is usually associated with low income and may contribute to the high rate of uncontrolled hypertension.

Also, smoking was another factor related to the prevalence of hypertension with p value= 0.013. This result demonstrates that smoking and diabetes contribute independently to increased risk of CVD [24]. As smoking and diabetes contribute to the development of cardiac dysfunction by promoting oxidative stress, inducing endothelial injury and leading to the formation of atheroma [25].

Data from this study indicated that duration of diabetes is significantly associated with the prevalence of hypertension. Where an increase in the duration is related to the severity of macro- and microvascular complications, both of which contribute to the progress of renal and/or atherosclerotic hypertension [26].

According to our study, we divided BMI into three groups (normal, overweight and obese). We found a high frequency of hypertension in the obese (n=103, 45.2%) then overweight (n=95, 41.6%) but there is no significant association in contrast to another study [20]. In addition, the presence of diabetes, hypertension, obesity and overweight increase the risk of cardiovascular complications and other morbidities [27].

Our study revealed that the prevalence of hypertension was high among participants who were physically inactive (n=190 patients, 83.3%), with no statistically significant association (P=0.417). Physical inactivity is recognized as the fourth leading cause of mortality worldwide, with approximately 1.4 billion individuals at risk of developing chronic diseases due to sedentary behaviours [28]. This finding can be explained by the fact that as populations age, individuals are more likely to develop hypertension and become less physically active. Scientific advancements have contributed to a better understanding of how physical activity improve blood pressure regulation, including clinically relevant ambulatory blood pressure, emphasizing its positive impact on cardiovascular health.

One of the factors affecting the occurrence of hypertension is congenital predisposition. Congenital factors such as genetic and family history play a significant role in the development of hypertension. Previous studies have shown that a family history of hypertension and diabetes are important risk factors with a significant effect on the occurrence of the disease. In addition, family history and diabetes mellitus, along with smoking behavior, were found to have a positive interaction with hypertension [29] this finding is consistent with our study, which revealed that hypertension was most prevalent among individuals with a combined family history of diabetes and hypertension (44.8%), followed by those with a family history of diabetes alone (35.1%) (P=0.000).

Glycemic control in this study was assessed using glycated hemoglobin (HbA1C) levels among diabetic patients, and participants were categorized into two groups: adequate glycemic control (HbA1C<7%) and inadequate glycemic control (HbA1C≥ 7%). The results indicate that the prevalence of hypertension was high among those with poor glycemic control (n= 173 patients, 75.9%), although the association was not statistically significant, this finding contrasts with previous studies that have reported a significant association between poor glycemic control and an increased risk of hypertension among diabetic patients [30] and another studies concluded the poor glycemic control is associated with increased risk of cardiovascular complications among type2 diabetic patients [31-33].

Several physiological mechanisms may explain this relationship. Elevated HbA1C levels are associated with

enhanced pro-inflammatory signaling and oxidative stress, which can contribute to arterial stiffness [34]. In addition, increased HbA1C concentration may lead to endothelial dysfunction by promoting endothelin release and inhibiting the synthesis of nitric oxide and prostacyclin, resulting in vasomotor imbalance and elevated blood pressure [35].

Loss of glycemic control may be contributed to poor adherence to treatment regimens or insufficient family support in maintaining consistent therapy.

Since this study employed a cross-sectional design with a relatively small sample size, the findings may not accurately represent the true distribution of hypertension among patients with type2 diabetes or the associated factors. Therefore, to determine the actual prevalence of hypertension in this population, large scale studies should be contributed by multidisciplinary research teams with the support of the Ministry of health or other relevant organization.

Conclusion

Our study showed the prevalent of hypertension in type2 diabetic patients nearly half participants, healthcare providers must be collaborated to reduce this complication by focus on educate the patient and family about the disease and its complication as well as medications compliance.

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