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# Prevalence of Hypertension among Diabetic Patients in Benghazi: A Study of Associated Factors

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***Authors' contributions***

*This work was carried out in collaboration between all authors. Author FN designed the study, performed the statistical analysis, wrote the protocol and wrote the first draft of the manuscript. Authors MO and MY reviewed the analyses of the study and the second draft. Author MO managed the literature searches. All authors read and approved the final manuscript.*

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## ABSTRACT

Diabetes mellitus (DM) and hypertension are diseases reported to be the first and second leading cause of all deaths in both developed and developing countries, including Libya. Increasing age, the presence of obesity, and worsening renal function all contribute to an increased likelihood of hypertension in people with diabetes; which makes both crucial public health concerns for the twenty first century. The purpose of this paper was to identify the prevalence of hypertension among diabetes patients in Benghazi via cross-sectional study. Moreover, it aimed to study the subjects' characteristics, anthropometric, and clinical variables contributing to this prevalence. The sample, representing subjects aged 30 years and older, consisted of 118 subjects, 72 of whom were females (61.02%), while 46 were males (38.99%). The current study reported (85.6%) prevalence of hypertension among diabetic patients in Benghazi. Age, sex, physical activity, duration of DM and basal body mass index (BMI) were the variables which associated with prevalence of hypertension among Benghazi diabetic patients.

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## 1. INTRODUCTION

Diabetes mellitus and hypertension are common diseases that coexist at a greater frequency than chance alone would predict [1-3]. Hypertension in the diabetic individual markedly increases the risk of peripheral vascular disease, stroke, retinopathy, nephropathy, and accelerates the course of cardiac disease [2-4]. Diabetic nephropathy is an important factor involved in the development of hypertension in diabetics, particularly type I patients. However, the aetiology of hypertension in the majority of diabetic patients cannot be explained by an underlying renal disease and remains "essential" in nature [5-6]. Population studies suggest that elevated insulin levels, which often occurs in type II diabetes mellitus, is an independent risk factor for cardiovascular disease [7,8]. Other cardiovascular risk factors in diabetic individuals include abnormalities of lipid metabolism, platelet function, and clotting factors [5].

Blood pressure is measured in millimetres of mercury (mm Hg) and is recorded as two numbers usually written one above the other. The upper number is the systolic blood pressure - the highest pressure in blood vessels and happens when the heart contracts, or beats. The lower number is the diastolic blood pressure - the lowest pressure in blood vessels in between heartbeats when the heart muscle relaxes. Normal adult blood pressure is defined as a systolic blood pressure of 120 mm Hg and a diastolic blood pressure of 80 mm Hg [2].

Data from several epidemiologic studies have suggested that the prevalence of hypertension in patients with diabetes mellitus is approximately 1.5-2.0 times greater than in an appropriately matched non-diabetic population [9-12]. In patients with insulin-dependent diabetes mellitus (IDDM), hypertension is generally not present at the time of diagnosis [7]. As renal insufficiency develops, blood pressure rises and may exacerbate the progression to end-stage renal failure [10]. In non-insulin-dependent diabetes mellitus (NIDDM), many patients are hypertensive at the time of diagnosis. The incidence of hypertension in NIDDM is related to the degree of obesity, advanced age and extensive atherosclerosis that is typically present, and it probably includes many patients with essential hypertension [11].

The incidence and prevalence of type 2 diabetes are increasing; it is projected that the total number of people with diabetes will rise from 171 million in 2000 to 366 million by 2030. The number of adults with hypertension is predicted to increase by 60% to a total of 1.56 billion people by 2025 [13]. Hypertension affects approximately 70% of patients with diabetes and is approximately twice as common in persons with diabetes as in those without [13].

Some prescription and over-the-counter medications, as well as supplements, can increase the blood pressure. These substances also can interfere with medications that used to decrease the blood pressure. Some pain and anti-inflammatory medications can cause water retention. Birth control hormones contain hormones that may raise the blood pressure by narrowing the small blood vessels. Most important, *insulin* can *increase blood pressure* through several mechanisms: Increased renal sodium re-absorption, activation of the sympathetic nervous system, alteration of transmembrane ion transport, and hypertrophy of resistance vessels [7,11-12].

The prevalence of coexistent hypertension and diabetes varies across different ethnic, racial, and social groups. Studies indicated that hypertension is higher among white Arabs than black ones. However, searching the indexes cannot find any information regarding different pattern of prevalence among Libyans and Benghazi not exception. Many factors put people at greater risk for high blood pressure besides uncontrolled diabetes; such as family history of heart disease, stress, high-fat, high-sodium diet, sedentary lifestyle, advanced age, obesity, smoking, too little potassium or vitamin D intake, too much alcohol, chronic diseases like kidney disease, diabetes, and/or sleep apnea [6,14]. Several other pathophysiological mechanisms also contribute to the genesis and maintenance of hypertension in the patient with diabetes. Hyperglycemia and increases in total-body exchangeable sodium may lead to extracellular fluid accumulation and expansion of the plasma volume.

The study was aiming to study the prevalence of hypertension among diabetic patients in Benghazi. Moreover, it aimed to study the socio-economic, anthropometric, clinical and chemical variables which contribute to this prevalence.

## 2. MATERIALS AND METHODS

### 2.1 Study Population and Design

This was a cross-sectional study carried out on adult of both sexes attending Sedi-Husain polyclinics in Benghazi city. The inclusion criterion for enrolment in the present study was all patients of DM attending the clinic at time of the study. Based on this criterion a total of 130 patients who visited Sedi-Hussein Polyclinic between 10th April and 13th May, 2013 (Period of data collection) were randomly approached to participate in the study. Out of these 130 patients, a total of 118 patients who answered the complete questionnaire clearly were finally enrolled for the study giving a response rate of 90.8%.

### 2.2 Ethics

Informed consent was obtained from the subjects who were also assured of the confidentiality of the information collected. The research was approved by the administration of the concerned polyclinic. Prior to the start of the project the respective polyclinic administration were informed in writing about the aim of the study to obtain the maximum possible cooperation to conduct the study.

### 2.3 Methodology

Data was collected with a structured questionnaire. Patients were approached at the respective polyclinic and briefed about the purpose of the study before questionnaire was administered. The questionnaires were reviewed for missing portion or ambiguity. Incomplete or unclear questionnaires were excluded from the study.

Questionnaire was divided into various sub-sections. The first section covered various characteristics including preliminary information as gender and age. An age verification procedure was used to ensure recording of accurate age. This included requesting the study recruit the age and date of birth followed by a confirmation by a document containing either or both of the above and/or verification of the age and/or date of birth by the accompanying person who was usually a close family member. There were other questions within this section about marital status, nationality, education, profession, type of housing, number of family members in the household, monthly personal or family income, smoking status and activity level. Physical activity levels were defined based on the contribution of the type, amount and frequency of self reported activities of subjects. Physical activity was compare with standard tables. These tables define sedentary persons as those who Engages only in activities of daily living and no moderate or vigorous activities. Low active persons have daily activity equivalent of at least 30 minutes of moderate activity depending on the intensity of the activity. Moderate active people were who engages in at least 60 minutes of moderate activities or a minimum of 30-60 minutes of vigorous activity.

The next part of the questionnaire consisted of a deta0iled section for obtaining information about chronic diseases among family members of subjects, chronic diseases among the subjects, monthly following-up with nutrition clinic, type of treatment, and following of special diet.

### 2.4 Anthropometry

Height and weight measurements used to calculate BMI were taken in a private area using standard techniques as recommended by the World Health Organisation WHO. Weight was measured with a SECA Platform lever scale (Germany) to the nearest 0.25 Kilogram (kg). Height or stature was measured using telescopic height rod attached to the SECA scale and recorded to the nearest 0.5 Centimetre (cm). BMI was calculated according to the formula: (weight in kilograms / (height in meter$^2$) [15].

### 2.5 Statistical Analysis

All data was coded prior to being entered in a computer. Description and analysis of data was carried by SPSS version 18. Level of significance was set at p value < 0.05.

### 2.6 DM and Hypertension

All included subjects were assigned as diabetic according to the records of the attending clinic which is diabetic and endocrinology centre. Patients were assigned as hypertensive if they were using antihypertensive medications such as initiate a thiazide-type diuretic initially for stage one hypertensive patients without compelling indications for other therapies. Drugs such as angiotensin converting enzyme (ACE) inhibitors, calcium channel blockers (CCBs), angiotensin receptor blockers (ARBs), beta-blockers, and diuretics are all considered acceptable

alternative therapies in patients with hypertension. Physicians were asked to confirm that each patients from the subjects was hypertension according to their records.

## 3. RESULTS

### 3.1 Subject Characteristics

A sample of 118, included 46 males (38.99%) and 72 females representing 61.02% of the total sample. The subjects were predominantly between the ages of 41-60 years old (53.5%). About 17% were between 30-40 years old while 18% were 61-70 years old (Table 1). The totals mean age±SD was 67.4 years.

A majority of subjects were married (79%) while approximately (7%) were either widowers or widows. A very small number was either unmarried (5%) or divorced (8.5%) as shown in Table 2.

Almost half (52.5%) of subjects were at level of basic education, with a much smaller number having secondary education or a corresponding level (26.3%) others had a university degree (21.2%). The house works and the government works formed the two biggest segments of the subjects: 43.2% and 34.75% respectively as can illustrated in (Table 2). Those currently employed who included free lancers made 6 % of the study group, while retirees made 16% of the study group. Other socio-economic characteristics pertaining to the monthly family income which is shown in Table 3. Most of subjects (46%) subsided on monthly family incomes of less than 500 Libyan Dinars (LD) while about (38%) lived within 500-1000 LD per month. Only 16% had access to monthly family income of more than 1000 LD.

**Table 1. Subject characteristics**

| **Age (Years)** | **Sex** | | | | **Total** | |
|---|---|---|---|---|---|---|
| | **Male** | | **Female** | | | |
| | **NO** | **%** | **NO** | **%** | | |
| 30-40 | 9 | 7.63 | 12 | 10.17 | 21 | 17.8 |
| 41-50 | 9 | 7.63 | 24 | 20.34 | 33 | 27.97 |
| 51-60 | 7 | 9.32 | 20 | 16.95 | 31 | 26.27 |
| 61-70 | 9 | 7.63 | 13 | 11.02 | 22 | 18.64 |
| ≥71 | 12 | 6.78 | 3 | 2.54 | 11 | 9.32 |
| **Total** | **46** | **38.99** | **72** | **61.02** | **118** | **100.00** |
| **Age (Years)** Mean±SD | 67.4 ± 6.8 | | 69.2±3.980 | | 68.02±4 | |

**Table 2. Socio-economic characteristics of subjects: marital status, education and occupation**

| **Characteristics** | **Male** | | **Female** | | **Total** | |
|---|---|---|---|---|---|---|
| | **Number** | **%** | **Number** | **%** | **Number** | **%** |
| Unmarried | 0 | 0 | 6 | 8.33 | 6 | 8.33 |
| Married | 46 | 100 | 48 | 66.67 | 94 | 166.67 |
| Widow/widower | 0 | 0 | 8 | 11.11 | 8 | 11.11 |
| Divorcee | 0 | 0 | 10 | 13.89 | 10 | 13.89 |
| **Total (N)** | **46** | **100** | **72** | **100** | **118** | **100.00** |
| Basic education | 19 | 41.30 | 43 | 59.72 | 62 | 52.5 |
| Secondary level | 14 | 30.44 | 17 | 23.61 | 54.05 | 54.05 |
| University degree | 13 | 28.26 | 12 | 16.67 | 44.93 | 44.93 |
| **Total (N)** | **46** | **100** | **72** | **100** | **118** | **100** |
| Government works | 23 | 50 | 18 | 25 | 48 | 75 |
| Free work | 7 | 15.22 | 0 | 0 | 7 | 22.22 |
| Retired | 16 | 34.78 | 3 | 4.17 | 19 | 38.95 |
| House Works | 0 | 0 | 51 | 70.83 | 51 | 70.83 |
| **Total (N)** | **46** | **100** | **72** | **100** | **118** | **100** |
| < 500 LD | 29 | 63.04 | 25 | 34.72 | 54 | 45.76 |
| 500-1000 LD | 13 | 28.26 | 32 | 44.44 | 45 | 38.14 |
| More than 1000 LD | 4 | 8.70 | 15 | 20.83 | 19 | 16.10 |
| **Total (N)** | **46** | **100** | **72** | **100.00** | **118** | **100** |

The self reported physical activity level is given in Table 3. Only 26.3% of subjects were sedentary at the time of the study while the remaining reported to be engaged in varying levels of physical activity: 37.3% as Moderate, 36.4% as Low active as shown in Table 3. Only 14.4% of the male subjects were smokers at the time of the study while none of female was smoker as shown in Table 3.

Table 4 lists the presence of any chronic disease among subject's family members and the types of the diseases accordingly. A majority (70.34%) of subject's family members had chronic disease with around 25.1% of these subjects having heart disease. Diabetes Mellitus were found in 45.6% of subjects while 29.2% had hypertension.

Table 5 lists the presence of any chronic disease among subjects and the types of the diseases. All subjects (100%) had chronic diseases, with around 4.5% of these subjects having heart disease. Diabetes Mellitus and hypertension were found in all of the subjects.

In term of of chronic diseases onset, in 14.4% of subjects hypertension diagnosed first before onset of diabetes mellitus, while the opposite happened in 85.6% when the diabetes mellitus started before hypertension (Table 6). In most of subjects the duration of DM was not longer than 10 years (61.9%). In 26.3% of subjects the duration of the diseases extends between 11 – 20 years, while in only 11.9% of subjects live with DM since 21 years or more details are shown in Table 6.

In most of subjects the duration of hypertension was no longer than 10 years (70.3%). In 29.7 % of the subjects the duration of the diseases extended between 11 – 20 years as shown in (Table 6). Most of the study subjects were attending nutrition clinic for follow ups at the study time 80.5% while only 19.5% did not follow with any nutrition clinic or nutrition care as shown in Table 7.

With regard to BMI; more than quarter of subjects (28%) had morbid obesity (BMI ≥ 40); and least percentage of sample belonged to normal BMI group (5.9%) as shown in Table 8.

## 3.2 Statistical Tests

Age, sex, physical activity, duration of DM, and BMI were the variables which associated with prevalence of hypertension among Benghazi diabetic patients at *P* (0.05) as shown in Table 9.

**Table 3. Self reported physical activity and smoking characteristics among subjects**

| Characteristics | Male | | Female | | Total | |
|---|---|---|---|---|---|---|
| | Number | % | Number | % | Number | % |
| Sedentary | 18 | 39.13 | 13 | 18.06 | 31 | 57.19 |
| Moderate | 10 | 21.74 | 34 | 47.22 | 44 | 68.96 |
| Low active | 18 | 39.13 | 25 | 34.72 | 43 | 73.85 |
| **Total (N)** | **46** | **100.00** | **72** | **100.00** | **118** | **100.00** |
| Smoker | 17 | 36.96 | 0 | 0 | 17 | 36.96 |
| Non- smoker | 29 | 63.04 | 72 | 100 | 101 | 164.04 |
| **Total (N)** | **46** | **100.00** | **72** | **100** | **118** | **100** |

**Table 4. Chronic diseases among the family members of subjects**

| Characteristics | Male | | Female | | Total | |
|---|---|---|---|---|---|---|
| | Number | % | Number | % | Number | % |
| **Chronic disease** | | | | | | |
| Yes | 28 | 60.87 | 55 | 76.39 | 83 | 137.26 |
| No | 18 | 39.13 | 17 | 23.61 | 35 | 62.74 |
| **Total (N)** | **46** | **100** | **72** | **100** | **118** | **100** |
| Hear diseases | 7 | 13.46 | 8 | 4.91 | 15 | 18.37 |
| Diabetes mellitus | 27 | 51.92 | 51 | 31.29 | 78 | 83.21 |
| Hypertension | 18 | 34.62 | 32 | 19.63 | 50 | 54.25 |

**Table 5. Chronic diseases among the subjects**

| Characteristics | Male | | Female | | Total | |
|---|---|---|---|---|---|---|
| | Number | % | Number | % | Number | % |
| Yes | 46 | 100 | 72 | 100 | 118 | 100 |
| No | 0 | 0 | 0 | 0 | 0 | 0 |
| **Total (N)** | 46 | 100 | 72 | 100 | 118 | 100 |
| Hear diseases | 4 | 5.26 | 10 | 7.69 | 14 | 12.96 |
| Hypertension | 35 | 60.53 | 66 | 55.38 | 101 | 85.6 |
| Renal diseases | 23 | 30.26 | 40 | 30.77 | 63 | 61.03 |

**Table 6. Onset and duration of chronic diseases**

| Characteristics | Male | | Female | | Total | |
|---|---|---|---|---|---|---|
| | Number | % | Number | % | Number | % |
| Hypertension first | 5 | 11.11 | 12 | 16.44 | 17 | 27.55 |
| Diabetes mellitus first | 40 | 88.89 | 61 | 83.56 | 101 | 172.45 |
| **Total** | **45** | **100** | **73** | **100** | **118** | **100** |
| **DM Duration (Years)** | | | | | | |
| 0-10 | 26 | 56.52 | 47 | 65.28 | 73 | 62 |
| 11-20 | 12 | 26.09 | 19 | 26.39 | 31 | 26.3 |
| 21 and above | 8 | 6.52 | 6 | 8.33 | 14 | 11.9 |
| **Total** | **46** | **100** | **72** | **100** | **118** | **100** |
| **Hypertension years** | | | | | | |
| 0-10 | 15 | 65.22 | 30 | 73.17 | 45 | 38.1 |
| 10-20 | 8 | 34.78 | 11 | 26.83 | 19 | 16.1 |
| **Total** | **23** | **100** | **41** | **100** | **54** | **45.8** |

**Table 7. Monthly following-up with nutrition clinic**

| Years | Male | | Female | | Total | |
|---|---|---|---|---|---|---|
| | Number | % | Number | % | Number | % |
| Yes | 35 | 76.09 | 60 | 83.33 | 95 | 80.5 |
| No | 11 | 23.91 | 12 | 16.67 | 23 | 19.5 |
| **Total** | **46** | **100** | **72** | **100** | **118** | **100** |

**Table 8. Distribution of subjects according to BMI**

| Years | Male | | Female | | Total | |
|---|---|---|---|---|---|---|
| | Number | % | Number | % | Number | % |
| 18- 24.9 | 6 | 13.04 | 1 | 1.39 | 7 | 5.9 |
| 25-29.9 | 10 | 21.74 | 10 | 13.89 | 20 | 16.9 |
| 30-34.9 | 12 | 26.09 | 16 | 22.22 | 28 | 23.7 |
| 35-39.9 | 10 | 21.74 | 20 | 27.78 | 30 | 25.4 |
| ≥ 40 | 8 | 17.39 | 25 | 34.72 | 33 | 28 |
| **Total** | **46** | **100** | **72** | **100** | **118** | **100** |

Age group was associated ($p< 0.05$) with prevalence of hypertension among Benghazi diabetic patients. As the age group increased there was an increase in the prevalence of hypertension among Benghazi diabetic patients. Older subjects had a higher percentage of those had hypertension. Likewise there were a greater percentage of subjects who do not have hypertension among younger diabetics.

Female gender was associated ($p< 0.05$) with less prevalence of hypertension among Benghazi diabetic patients.

Among the self reported physical activity characteristics, activity level was associated ($p< 0.05$) with the prevalence of hypertension among Benghazi diabetic patients. The sedentary diabetic had greater percentage of hypertension.

**Table 9. Association of subjects variables with prevalence of hypertension among Benghazi diabetic patients**

| Characteristics | Prevalence of hypertension among Benghazi diabetic patients % | No Prevalence of hypertension among Benghazi diabetic patients % |
|---|---|---|
| **Age** | | |
| 30-40 | 12.4 | 87.6 |
| 41-50 | 21 | 79 |
| 51-60 | 36.8 | 63.2 |
| 61-70 | 65.4 | 34.6 |
| ≥71 | 100 | 0 |
| Male | 77 | 23 |
| Female | 49.5 | 51.5 |
| Sedentary | 77.6 | 22.4 |
| Low active | 37.5 | 62.5 |
| Moderate active | 29.7 | 70.3 |
| **Duration of DM (Years)** | | |
| 0-10 | 18 | 82 |
| 11-20 | 33.8 | 66.2 |
| 21 and above | 89.8 | 10.2 |
| **BMI** | | |
| 18- 24.9 | 17.8 | 82.2 |
| 25-29.9 | 26 | 74 |
| 30-34.9 | 29.3 | 70.7 |
| 35-39.9 | 66.9 | 33.1 |
| ≥ 40 | 71.1 | 28.9 |

Among those who were active, a higher activity level was associated with a less prevalence of hypertension.

Years of DM duration were associated ($p < 0.05$) with the prevalence of hypertension among Benghazi diabetic patients Hypertension was less prevalent among subjects who had the least duration of DM.

BMI was associated ($p < 0.05$) with prevalence of hypertension among Benghazi diabetic patients. Subjects classified as underweight according to their BMI had the least percentage of having a hypertension. Nevertheless, even the normal BMI group had subjects who were hypertensive.

Although most of the subjects (80.5%) are attending nutrition clinic; there was no association between this variable and prevalence of hypertension among diabetic patients in Benghazi.

## 4. DISCUSSION

To the best of our knowledge, this is the first study from Benghazi to assess the prevalence of hypertension among diabetic patients in Benghazi. This research is opening the door for new significant and worthwhile area of investigation in Benghazi. Control of hypertension among patients with diabetes can largely affect cardiovascular diseases outcomes because the relationship between hypertension and risk of cardiovascular diseases events is continuous, consistent, and independent of other risk factors [16]. The current study reports (85.6%) prevalence of hypertension among diabetic patients in Benghazi. Age, sex, physical activity, duration of DM, and BMI were the variables associated with prevalence of hypertension among Benghazi diabetic patients at *P* (0.05).

In the various global studies identifying the prevalence of hypertension among diabetic patients, covering over 30,000 patients' subjects in various settings, the diabetic patients had a 70% mean prevalence of hypertension [17]. Data from several epidemiological studies have suggested that the prevalence of hypertension in patients with diabetes mellitus is approximately 1.5-2 times greater than in an appropriately matched non-diabetic population [18]. In patients with insulin-dependent diabetes mellitus (IDDM), hypertension is generally not present at the time

of diagnosis. The incidence of hypertension in NIDDM is related to the degree of obesity, advanced age, and extensive atherosclerosis that is typically present, and it probably includes many patients with essential hypertension. The incidence and prevalence of type 2 diabetes are increasing; it is projected that the total number of people with diabetes will rise from 171 million in 2000 to 366 million by 2030. The number of adults with hypertension is predicted to increase by 60% to a total of 1.56 billion people by 2025. Hypertension affects approximately 70% of patients with diabetes and is approximately twice as common in persons with diabetes as in those without. The prevalence of coexistent hypertension and diabetes varies across different ethnic, racial, and social groups [19-22].

In general, fewer than 25 percent of diabetics have good control of their blood pressure. The presence of high blood pressure in diabetes is associated with a 4 fold increase in death chiefly from heart disease and strokes.

In this study, Age group was associated ($p< 0.05$) with prevalence of hypertension among Benghazi diabetic patients [23]. Ageing is generally associated with a decline in various physiological functions [10,23] having pathophysiological implications on diabetic patients [11,24] and possibly leading to incidence of hypertension among diabetics [13]. Increasing age has also been linked with a higher incidence of disease and disability [25].

The high blood pressure is gradual at early stages and may take at least 10–15 years to fully develop; which means that increasing in years of age associated with appearance of symptoms and complications of hypertension among diabetic patients. Increasing age also brings with it economic deprivation as earnings decrease, if not cease all together for diabetic patients [25]. The lower the income, the less likely an adequate and varied diet and medications will be used which increases the risk of developing hypertension [10].

Female gender was associated ($p< 0.05$) with less prevalence of hypertension among Benghazi diabetic patients. Females as compared to males had a lower percentage of hypertension among Benghazi diabetic patients. This could however be partly attributed to the higher mean age ($p < 0.05$) of males in this study as compared to females. Age per se is known to be a possible factor for developing of hypertension among the diabetic patients [26]. A higher age group has already been found to be associated ($P <0.05$) with development of hypertension among the diabetic patients. No other characteristic could be identified statistically to explain better the hypertension prevalence of females in this study as compared to male subjects.

Among the self reported physical activity characteristics, activity level was associated ($p< 0.05$) with the prevalence of hypertension among Benghazi diabetic patients. The sedentary diabetics had greater prevalence of hypertension.

Among those who were active, a higher activity level was associated with a less prevalence of hypertension. Sedentary lifestyle adversely affects the quality of life, threatens independent living and personal autonomy and increases both formal and informal care needs [6]. It also has adverse effects on physical health since inactivity increases the risk of many diseases like hypertension, cardiovascular disease among diabetic patients. While for most adults the single most important health message is to achieve or maintain at least moderate levels of physical activities [6]. Physical activity in general declines among diabetic patients who developed hypertension [3]. There are reports documenting that around a third of diabetic patients who developed hypertension do not participate in any leisure time physical activity [24]. A decline in physical activity may be a result of health retardation [11]. No group can benefit more than the diabetic patients who developed hypertension from regularly performed exercise and the WHO also recommends the diabetic patients who developed hypertension to be physically active on a regular basis and to include exercise that strengthen muscle and improve balance [4]. Exercise has long been recommended for preventing and treating a number of chronic and typically comorbidity like non-insulin dependent diabetes mellitus, hypertension, heart disease and osteoporosis exercise also counteract the age related increase in body fat [4,10,25].

Years of DM duration were associated ($p < 0.05$) with prevalence of hypertension among Benghazi diabetic patients Hypertension was less prevalent among subjects who had less years of DM. Long-term complications of diabetes develop gradually. Long term diabetes dramatically increases the risk of various cardiovascular problems, including high blood

pressure, coronary artery disease with chest pain (angina), heart attack, and stroke and narrowing of arteries (atherosclerosis) [27-29].

BMI was also associated ($p < 0.05$) with prevalence of hypertension among Benghazi diabetic patients The subjects classified as underweight according to their BMI had the least prevalence of hypertension. However even the normal BMI group had subjects who were had hypertension. It has been found that BMI alone does not detect many patients at risk of development of hypertension among the frail diabetic patients who visit a general practitioner or were clinic outpatients [27,30]. As BMI alone has been shown to be unable to identify prevalence of hypertension in the obese diabetics [27].

Recent research reflect that the health risk due to excess weight appear to be the same for diabetic patients who have hypertension as for diabetic patients who do not have hypertension. Adults and older adults may improve their health by losing weight.

Although most of the subjects (80.5%) are attending nutrition clinic and Populations eating mainly vegetarian diets have lower blood pressure levels than those eating omnivorous diets. Epidemiologic findings suggest that eating fruits and vegetables lowers blood pressure. Diet may offer an alternative to drug therapy in hypertensive people and, as a population approach, may prevent hypertension. [31]; there was no association between this variable and prevalence of hypertension among diabetic patients in Benghazi. One justification showed that the occurrence of these combined diseases occurred a long time ago while the attendance of the dietitian clinic was recently. Another justification and limitation of the study were that the study did not ask about the followed dietary pattern whether dietary approach to stop hypertension, low glycemic diet or both.

## 5. STUDY LIMITATIONS

Although the study assess all patients who met the inclusion criteria during the study period, some factors may influence the generalizability of results and should be noted when comparing to results from different institutions, populations and regions. A limiting factor is the small sample size. Furthermore, the current study did not assess some variables such as medications and dietary habits of the subjects and their influences of the prevalence of hypertension among diabetic patients in Benghazi. Further studies need to focus on strategies on raising health professional knowledge and awareness of this co-morbidities and related risk factors. Despite these limitations, this work provides new insights into hypertension prevalence among diabetic patients, and recognition of associated factors, and it provides a base for this field which; to our knowledge, hasn't been covered before.

## 6. CONCLUSION

The diabetic population is increasing globally, including those who have hypertension beside diabetes mellitus. Prevalence of hypertension among diabetic population brings with it various physiological changes which influence the general health status. A variety of personal, physical, and anthropometrical factors are contributory towards making diabetic patients a potentially vulnerable group for developing hypertension.

## CONSENT

As per international standard or university standard, patient's written consent has been collected and preserved by the authors.

## ETHICAL APPROVAL

As per international standard or university standard, written approval of Ethics committee has been collected and preserved by the authors.

## COMPETING INTERESTS

Authors have declared that no competing interests exist.

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