

## Hypertension and Dyslipidemia among Type II Diabetic Patients and Related Risk Factors and Complications

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### Abstract

**Background:**Diabetics are likely to develop hypertension. Hypertension occurs in about 70% of type II diabetics moreover, it clusters with other cardiovascular risk factors such as obesity, insulin resistance and dyslipidemia.**Objective:**To estimate the prevalence of hypertension and dyslipidemia amongtype II diabetic patients and to identify common risk factors and complications of type II diabetes with hypertension.**Methods:**A Cross sectional study was conducted on type II diabetics attending outpatient clinics at Zagazig University and El-Ahrar Hospitals.Participants were selected by systematic random sampling. Data were collected about participants' socio-demographic characteristics, life style risk factors, andexistent diabetic complications.Blood pressure, Body Mass Index,serum fasting glucose, total cholesterol, and triglyceride levels were measured.**Results:**Prevalence of hypertension, hypercholesterolemia and hypertriglyceridemia were 68%, 57.3%, and 47% respectively. Hypertension significantly occurred among female, elderly,and low social patientsand associated with family history of DM, physical inactivity or not following diabetic diet. Diabetic hypertensive patients were significantly obese and havinghigh cholesterol and fasting blood sugar (FBS). They were significantly complicated with FBS >300 mg/dl, ocular and cardiovascular diseases.**Conclusion:**There was increased prevalence of hypertension and dyslipidemia among type II diabetics. Hypertension was common in low social old aged obese diabetic patients not following diabetic diet and regular exercise and those with high cholesterol and fasting blood sugar. Hypertensive diabetics were prone to many complications as hyperglycemia, ocular problems and CVD.**Recommendations:**Further studies are needed to explore related risk factors of hypertension and dyslipidemia among type II diabetics, Health education programs are recommended for both clinicians and diabetic patients for early detection and management of hypertension and dyslipidemia.

**Key words:***Hypertension, Dyslipidemia, Prevalence, Type II diabetes, Risk factors, Complications.*

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### Introduction

Recently, diabetes and other non-communicable diseases that share similar risk factors represent a prominent threat to human health and development. Every year in developing countries about 8 to 14

million person are exposed to premature death as a cause of preventable non communicable diseases mainly cardiovascular diseases CVD, diabetes, and chronic respiratory diseases<sup>1</sup>.

Diabetes is recognized as a group of heterogeneous disorders with the common elements of hyperglycemia and glucose intolerance, due to insulin deficiency, impaired effectiveness of insulin action or both<sup>2</sup>. The number of people with diabetes is increasing all over the world as a cause of several factors as population growth, aging, physical inactivity, and obesity<sup>3</sup>.

The global prevalence of diabetes among adults (aged 20–79 years) is 6.4%, affecting 285 million adults, in 2010, and will increase to 7.7% and 439 million adults by 2030<sup>4</sup>. In Egypt The prevalence percentage adjusted to world population in 2010 is 11.4 and will be 13.7 in 2030, number of adults with diabetes in 2010 is 4.787million and will be 8.6 million in 2030<sup>4</sup>.The International Diabetes Federation (IDF) has recognized Egypt as the ninth leading country in the world for the number of type II diabetes patients and its prevalence was nearly tripled over the last 2 decades<sup>5</sup>.

There is a close relationship between diabetes and hypertension that has been recognized since the 1980s<sup>6</sup>. Diabetics are likely to develop hypertension<sup>7</sup>. Approximately, 85%-95% of diabetics suffer from type II diabetes. Among Type I diabetic patients, hypertension occurs in only 30% of cases, while 70% of patients with type II diabetes have hypertension<sup>8,9</sup>. Commonly, hypertension in type II diabetic persons clusters with some risk factors such as central obesity, insulin resistance, dyslipidemia, hyper-coagulation and left ventricular hypertrophy<sup>10</sup>. This clustering result in the development of several complications especially CVD, which is the major cause of premature mortality in type II diabetic patients<sup>10,11</sup>.Among middle aged and elderly Egyptians it was identified that, there is a high prevalence of metabolic

syndrome in 55% among all of them, 76.6% among hypertensive patients and 85.6% among diabetics<sup>12</sup>.

Diabetes mellitus is now the fourth or fifth leading cause of death in most high-income countries and there is considerable evidence that it is epidemic in many economically developing and newly industrialized nations<sup>3</sup>. Hypertension is twice as common in people with diabetes as in those without<sup>13</sup> while it is under diagnosed and undertreated among diabetics<sup>9</sup>. Hypertension doubles the risk of cardiovascular events<sup>8</sup>. Therefore, the aim of this study is to estimate the prevalence of hypertension and dyslipidemia among patients with type II diabetes mellitus in Zagazig district hospitals, and to study some common risk factors and complications of type II diabetes with hypertension.

## Methods:

**Study design and setting:** A Cross sectional study was carried out on type II diabetic patients attending diabetic outpatient clinics at Zagazig University and El-Ahrar Hospitals for a period of three months from 1st June to the end of August 2015. Diabetic Outpatient Clinic at Zagazig university hospital and El-Ahrar Hospital were chosen to conduct this study as they act as a first health care contact serving Zagazig city population and adjacent rural areas, they service about 2000 patients per month, and they are sites for giving free medication to diabetic patients so the drop out of patients was expected to be minimal.

**Study Population and Sampling:** The target population included type II diabetic patient attending diabetic outpatient clinic at Zagazig university hospital and El-Ahrar Hospital. Assuming that the prevalence of hypertriglyceridemia among Type

Diabetic patients was (25.5%)<sup>14</sup> with total population (outpatient clinics attendants) was 2000, the estimated sample size was 252 plus 20% non-response. So the total sample size was 300 participants calculated by Epi- info program version 6 with a confidence interval 95% and 80% as the power of test. Our participants were selected by the systematic random sampling technique. Listing of the patients was done two days per week then every 3rd patient coming to the clinic in those days and fulfilling the inclusion criteria was chosen after a random starting point.

**Inclusion criteria:** Not hospitalized apparently uncomplicated type II diabetic patients above 40 years old (the peak age of type 2 diabetes incidence)<sup>15</sup> who attended diabetic outpatient clinic and fasting from 12-14 hours for taking a blood sample for laboratory investigation.

**Exclusion criteria:** Not hospitalized complicated type II diabetic patients <40 years old and smoker patients.

**Data collection:** A structured questionnaire was used to collect data regarding the participants' socio-demographic as: age, sex, social class (social class was classified as low class <50%, moderate class ≥50-75%, high class ≥75%)<sup>16</sup> and family history of DM among first degree relatives and some life style risk factors as: regular physical activity (it is defined as 30 minutes or more a day 3 times/week or daily physical activity lasting at least 20 min daily or 1 hour of physical activity twice a week)<sup>17</sup>, and following the diabetic diet as well as the presence of other diabetes complications.

**Clinical examination:** Blood pressure has been measured once in sitting position following the standard precaution<sup>18</sup> and patient was considered hypertensive when systolic blood pressure was more than 140 mmHg

and diastolic blood pressure was more than 90 mmHg<sup>19</sup>. Body Mass Index BMI of participants was calculated (considering < 18 is under weight, from 18 to ≤ 25 is normal weight, from 25 to ≤ 30 is overweight, and > 30 is obese)<sup>20</sup>. **Laboratory investigations:** One blood sample (3 ml) was obtained from each participant included in the study. Serum fasting glucose, serum total cholesterol, and fasting plasma triglyceride were determined using the enzymatic method. DM type II patient defined as the person who has symptoms of diabetes and or fasting blood glucose of >126 mg/dl<sup>21</sup>. Cholesterol level < 200 mg/dl was considered normal, 200 - 250 mg/dl was borderline high and > 250 mg/dl was high and Triglyceride level <150 mg/dl were defined as normal, 150 - 200 mg/dl as borderline high and > 200 mg/dl as high risk. Dyslipidemia was defined as the presence of one or more of the previous abnormalities in serum lipids or patient receiving medications for this condition<sup>22</sup>. Metabolic syndrome was defined as having central obesity (BMI is >30kg/m<sup>2</sup>) plus any two of the following four factors: elevated triglycerides ≥150 mg/dl, reduced HDL (good) cholesterol in men <40 mg/dl and in women <50 mg/dl, elevated blood pressure ≥130/85 mmHg, and elevated fasting glucose ≥100 mg/dl<sup>23</sup>.

**Ethical consideration and administrative approach:** The necessary official permission was taken from the manager of diabetic outpatient clinics at Zagazig University and El-Ahrar Hospitals. An informed consent was obtained from the participants and they were reassured about the confidentiality of information and the results were used for the purpose of the scientific research and they were also given the right to refuse or participate in the study.

**Pilot study:** A pilot study was carried out before starting data collection which involved 30 selected type II diabetic patients who were not included in the study to test the clarity and applicability of the questionnaire and necessary modifications were made accordingly.

**Statistical Analysis:** Statistical analysis was conducted using SPSS software version 19.0. Qualitative data were represented in tables and figures as frequencies and relative percentages. Chi square and t-tests were used to calculate significant differences between hypertensive and non-hypertensive type II diabetic patients.

## Results

Figure (1) shows that, the prevalence of hypertension was 68% among the studied type II diabetic patients. 57.3% of the studied patients had high cholesterol level and 47% of them had high triglyceride level. The criteria of metabolic syndrome had been fulfilled in 84% of the studied patients.

Table (1) reveals that, hypertension was significantly occurred in female and older aged diabetic patients. Low social class, positive family history of DM, and regular physical exercise were significantly associated with hypertensive diabetic patients. Also, there were significant differences regarding following diabetic diet between both hypertensive and non-hypertensive diabetic patients in favour to non-hypertensive ones.

Table (2) shows that, both Systolic and Diastolic Blood Pressures were significantly higher among the hypertensive diabetic patients. Hypertension with diabetes was significantly associated with obesity, border high and high cholesterol and high fasting blood sugar levels.

Table (3) illustrates that, diabetic hypertensive patients were statistically significantly more likely to have FBS above 300 mg/dl and complaining of eye problems and cardiovascular diseases CVD than Diabetic non hypertensive ones.

## Discussion

The relation between type II diabetes and essential hypertension has the potential to provide insight into the mechanisms that operate this complex interaction<sup>24</sup>. The current study aimed to estimate the prevalence of hypertension and dyslipidemia among patients with type II diabetes mellitus in Zagazig district hospitals, and to study some common risk factors and complications of type II diabetes with hypertension.

There is considerable evidence for an increased prevalence of hypertension in diabetic persons and in the USA population; hypertension occurs in about 50% to 80% of type II diabetes patients<sup>25</sup>. Also, in the current study the prevalence of hypertension was 68% among the studied type II diabetic patients (Figure 1). This finding was consistent with other previous studies<sup>26,27</sup>, while higher in percentage than a study among type II diabetic patients in Kuwait<sup>14</sup> which concluded that hypertension was present in only 56% of their patients. Also diabetic hypertensive patients showed higher levels of SBP, DBP than diabetic non hypertensive ones with statistical significance difference ( $p < 0.001$ ) (table 2). The present study showed high prevalence of dyslipidemia among the studied diabetic patients (Figure 1) which was in agreement with two previous studies<sup>27,28</sup> the former one showed lower percentage of total cholesterol and slightly higher triglyceride levels (46% and 49%) respectively, while a study in Kuwait<sup>14</sup> reported that 67% of their

diabetic patients had high total cholesterol and 25% of them had high triglycerides. The pathophysiology of dyslipidemia in type II DM is complex and multifactorial<sup>29</sup>. Studies have shown that improved glycemic control can lead to promising changes in HDL-cholesterol and triglyceride levels<sup>30</sup>. It was revealed that 84% of the studied type II diabetic patients have metabolic syndrome (Figure 1) which was much higher than a previous study<sup>28</sup> revealed that 31.7% of studied Saudi type II diabetic patients had metabolic syndrome. This can be explained by higher prevalence of obesity, uncontrolled FBS and higher prevalence of hypertension among the studied sample which fulfill the inclusion criteria of metabolic syndrome.

The present study showed that the mean ages of both hypertensive and non-hypertensive diabetic groups were ( $56.58 \pm 6.74$ ) and ( $52.02 \pm 7.69$ ) respectively (Table 1), which was very near to the results found by previous studies<sup>26, 27</sup>. The risk of hypertension had been significantly increased when diabetic patients became older<sup>31</sup>. Numerous epidemiological studies showed that the frequency of hypertension is higher among elderly population<sup>32,33,34</sup>. An epidemiological study revealed that, incidence of hypertension is more than doubled in the aged than in the young population<sup>35</sup>. In agreement with the previous studies we found that hypertension was significantly occurred older aged diabetic patients (Table 1).

Hypertension incidence was increased in women higher than in men especially after the fifth decade of life<sup>36</sup> and several survey studies showed the diabetic female predominance<sup>14,27,37</sup>. Hypertension had a significant tendency to affect female diabetic patients more than males<sup>38</sup>. These results were consistent with our results revealing that the diabetes was more

predominant among females and the hypertension was significantly higher among female diabetic patients than male ones (Table 1). The impact of gender on the incidence of hypertension remains poorly clarified<sup>39</sup>. Possible explanations for diminished hypertension control in older women compared to older men include poorer adherence to prescribed medications or lifestyle recommendations and physiological differences because of vascular stiffness and/or sex hormones<sup>40</sup>.

Regarding the social class, the majority of the studied diabetic patients were of low social class with significant association with hypertension (Table 1). This finding was consistent with the results of a cross sectional study revealing that the prevalence of both hypertension and diabetes was significantly increased among low social classes in rural area<sup>41</sup>. A study conducted in Pakistan<sup>27</sup> revealed that, the majority of their survey study was of low social class. However, other study revealed that high social classes had greater prevalence of hypertension and diabetes<sup>42</sup>. The association between family history of diabetes and its occurrence has been well recognized<sup>43</sup>. Recent studies have shown the graded contribution of a positive family history to escalating risk for diabetes<sup>44,45</sup>. The inherited nature of hypertension is well recognized by numerous studies<sup>46</sup>, indicating association of hypertension with positive family history<sup>(47)</sup>. The prevalence of diabetes in newly diagnosed hypertensive patients was significantly higher in those with a family history in siblings<sup>48</sup>. This is in agreement with our finding revealed that, the positive family history of diabetes was significantly associated with hypertension (Table 1). Therefore, positive family history can be considered as a great chance for concerning direct family members and

siblings in health education interventions for diabetes and hypertension.

Accomplishing recommended levels of physical exercise is a public health priority, and essential line measure in managing of type II diabetes and hypertension<sup>49,50</sup>. There was a great association between physical activity and improvement of both hypertension and diabetes<sup>51</sup> and it is considered a non-pharmacological intervention in controlling diabetes and reducing blood pressure<sup>49,50</sup>. Also, six years follow up study on type II diabetic patients revealed that, regular physical exercise with following diabetic diet is strongly associated with normalizing glucose tolerance and controlling blood pressure, hyperlipidemia and hyperinsulinemia<sup>52</sup>. In agreement with the previous findings we found that, there was a significant association between non-following regular physical activity and diabetic diet and occurrence of hypertension in the studied diabetic patients (Table 1).

USA has a high prevalence of obesity and overweight among the diabetic population<sup>53</sup>. Also, an Egyptian study<sup>3</sup> showed that, only 88.3% of Egyptian diabetics are overweight and obese which have a negative prognosis on their condition. Improvement in glucose tolerance in type II diabetic patients was correlated to weight reduction ( $r=0.19$ ,  $p<0.02$ )<sup>52</sup>. The incidence of hypertension in type II diabetic patients is related to the degree of obesity<sup>53</sup>. In accordance with the previous findings our results revealed that, obesity was significantly higher among the hypertensive diabetic group than the non-hypertensive one (Table 2).

The findings of our study shown that, hypertension was significantly associated with hypercholesterolemia ( $P<0.05$ ) (Table 2). Several studies have consistently

indicated frequent coexistence of hypertension and hypercholesterolemia; resulting in what is termed as dyslipidemic hypertension (DH) and its prevalence in the United States among elderly diabetic patients was 31%<sup>54,55</sup>. Also, the co-occurrence of dyslipidemic hypertension has been named as "Lipitension"<sup>19</sup>. High fasting blood glucose is associated with a higher prevalence of hypertension independent of other cardiovascular risk factors<sup>6</sup>. High fasting plasma sugar levels were significantly associated with hypertension in both genders, with ORs of 1.24 (95 % CI, 0.85–1.80)  $p<0.05$  in male patients and 1.61 (95 % CI, 1.12–2.30)  $p<0.01$  in female patients respectively<sup>6</sup>. The previous result is in agreement of ours which revealed that, fasting blood glucose was significantly higher among hypertensive diabetic patients than non-hypertensive ( $P= 0.01$ ) (Table 2).

Regarding the incidence of complications among the hypertensive and non-hypertensive diabetic patients our study illustrated that, FBS above 300 mg/dl and eye problems and cardiovascular diseases CVD were significantly higher among hypertensive diabetic patients (Table 3). These results were consistent with several studies; In a Japanese cohort study after adjustment of age and gender an elevated concentration of fasting blood glucose was associated with hypertension (OR= 1.35) during a 5-year follow-up<sup>56</sup> and a study among Southern European found that, subjects with high FBS had more than two times the risk for association with hypertension than those with normal FBS<sup>57</sup>. The incidence of diabetic retinopathy is related primarily to duration and control of diabetes and is significantly related to hypertension<sup>58</sup>. The co-

occurrence of dyslipidemic hypertension condition has proved to have adverse outcomes as interaction between hypertension and dyslipidemia occurs at the vascular endothelial level which results in augmented oxidative stress, endothelial dysfunction, and development of atherosclerosis and ends with a severe CVD<sup>59</sup>. The risk of CVD associated with coexistent hypertension and dyslipidemia is considered more multiplicative than the individual risk factors which emphasizing the need to quantify a person's overall CVD risk<sup>60</sup>. Strict control of hypertension has been recommended to be beneficial in controlling diabetic complications<sup>61</sup>.

### Conclusion and Recommendations

There was considerable evidence for an increased prevalence of hypertension and dyslipidemia among studied type II diabetic patients. Hypertension was significantly occurred in female, older aged, low social class diabetic persons and also with those with positive family history of DM, and following regular physical exercise. Hypertension was significantly associated with not following diabetic diet, obesity, border high and high cholesterol and high fasting blood sugar levels. Finally, hypertensive diabetic patients were significantly prone to many complications as hyperglycemia, ocular problems, and CVD.

It is recommended that, the material discussed here regarding high prevalence of hypertension and dyslipidemia among type II diabetic patients and related complications help to proactively screen individuals who may benefit from further investigations or management, and refer complicated cases for specialized care. Further studies are needed to explore related risk factors of hypertension and

dyslipidemia among type II diabetic patients, Health education programs are recommended for clinicians, type II diabetic patients and their family members to increase their awareness for early detection and management of both hypertension and dyslipidemia. The management of these disorders, especially in diabetic patients, requires multiple dietary and pharmacological interventions.

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**Table 1: Socio-demographic and life style factors among the hypertensive and non-hypertensive diabetic patients**

Risk factors	DM with HPN 203 (%)	DM without HPN 97 (%)	$\chi^2$	P
<b>Sex</b>				
Male	86 (42.4)	27 (27.8)	5.90	0.02*
Female	117(57.6)	70 (72.2)		
<b>Social class</b>				
Low	176(86.7)	72 (74.2)	7.12	0.01*
Moderate	27 (13.3)	25 (25.8)		
<b>Family history of DM</b>				
Yes	132(65.0)	46 (47.4)	8.42	0.004*
No	71(35.0)	51 (52.6)		
<b>Physical exercise</b>				
Yes	6 (3.0)	27 (27.8)	41.5	<0.001*
No	197 (97.0)	70 (72.2)		
<b>Follow diabetic diet</b>				
Yes	21(10.3)	20 (20.6)	5.87	0.01*
No	182 (89.7)	77 (79.4)		
<b>Age (Mean±SD)</b>	56.58 ± 6.74	52.02 ± 7.69	4.99 <sup>#</sup>	0.003*

# t-test; \*Significant

**Table 2: Physical and biochemical profiles of the hypertensive and non-hypertensive diabetic patients**

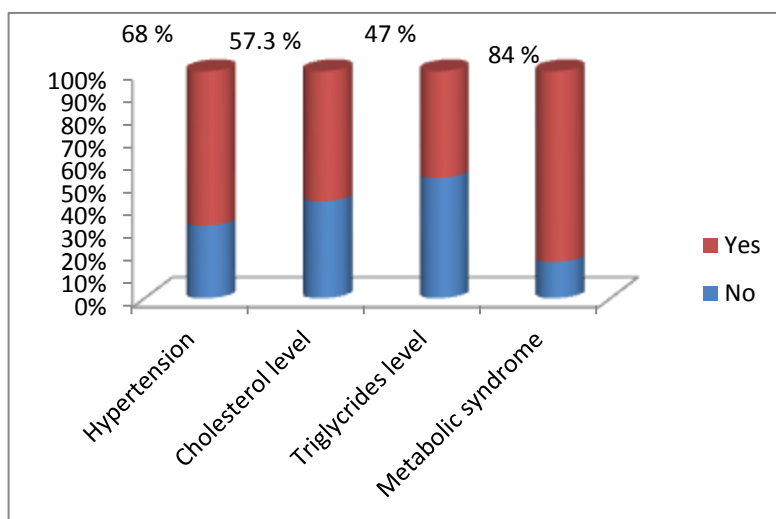
Physical and biochemical variables	DM with HPN N=203 N (%)	DM without HPN N=97 N (%)	$\chi^2$	P
<b>Systolic Blood Pressure SBP</b>				
Normal <135mm.Hg	91 (44.8)	86 (88.7)	52.1	<0.001*
High ≥135mm.Hg	112 (55.2)	11 (11.3)		
<b>Diastolic Blood Pressure DBP</b>				
Normal <85mm.Hg	33 (16.3)	67 (69.1)	82.4	<0.001*
High ≥85mm.Hg	170 (83.7)	30 (30.9)		
<b>BMI</b>				
Normal	14 (6.9)	17 (17.6)	11.9	<0.001*
Overweight	34 (16.7)	24 (24.7)		
Obese	155 (76.4)	56 (57.7)		
<b>Total cholesterol</b>				
Desirable	77 (37.9)	51 (52.6)	5.75	0.02*
Borderline high & High	126 (62.1)	46 (47.4)		
<b>Triglycerides</b>				
Desirable	115 (56.7)	44 (45.4)	3.35	0.07
Borderline high & High	88 (43.3)	53 (54.6)		
<b>Fasting Blood Sugar FBS</b>				
Normal	41 (20.2)	32 (33.0)	5.83	0.01*
High	162 (79.8)	65 (67.0)		

\*Significant

**Table 3: Incidence of complications among the hypertensive and non-hypertensive diabetic patients**

DM complications	DM with HPN N=203 N (%)	DM without HPN N=97 N (%)	$\chi^2$	P
Hypoglycemic coma	37 (18.2)	12 (12.4)	1.647	0.199
FBS >300 mm/dl	58 (28.6)	15 (15.5)	6.125	0.013*
Neuropathy	152(74.9)	68 (70.1)	0.765	0.382
Eye problems	73 (36.0)	23 (23.7)	4.526	0.033*
CVD	82(40.4)	18 (18.6)	14.085	<0.001*
Renal diseases	10 (4.9)	2(2.1)	1.402	0.237
Diabetic foot	2 (0.98)	3(3.1)	1.779	0.182
Infections	92 (45.3)	36 (37.1)	1.807	0.179

\*Significant

**Figure 1: Prevalence of hypertension, dyslipidemia and metabolic syndrome among the studied diabetic patients**