Factors lead to uncontrolled diabetes mellitus among Libyan patients with type 2 diabetes

[1]Khadija Faraj Ben Amer and [2]Samia A. Ali Elmiladi
[1]Dispensary-Diabetic clinic and [2]National Diabetes Hospital, University of Tripoli, Faculty of Medicine, Tripoli, Libya

Abstract: Diabetes mellitus (DM) is a major cause of morbidity and mortality, good glycemic control can prevent or delay the complications associated with chronic hyperglycemia. To identify the proportion of controlled and uncontrolled diabetes among Libyan patients with type 2 diabetes mellitus (T2DM) depend on fasting blood sugar (FBS) levels and to identify the possible causes that may lead to poor glycemic control. A cross sectional study, conducted at Tripoli outpatient-diabetic clinic in three primary healthcare centers (PHC) during a period of September and October 2015. 400 cases were participated and selected by systematic random sampling according to the number of the patients attending to each center and a pre structural questionnaire was used to collect the data from the selected patients (age, obesity, sex, educational level, smoking, any associated psycho-emotional event and family history). Of the total 400 diabetics, the percentage of controlled and uncontrolled diabetes depend on FBS level was 33.2% and 66.8% respectively with mean FBS of 168.54 ± 70.545 mg/dl ($p < 0.001$). The age of the patients interviewed ranged between 19-80 years with mean age of 56.2 ± 11.5. The highest frequency of uncontrolled diabetes mellitus (UDM) versus controlled diabetes mellitus (CDM) analysis in the study group recorded among patients aged 32-44 years (71%) attained college education (75%) and working (68.6%), despite male to female ratio in the study group was 1 : 2. The study found that the UDM regarding the sex was approximately equivocal due to insignificant difference between male to female ratio accounted 66.7 : 66.8, respectively. Statistical analysis of the personal data of age, sex, working status and educational level did not show statistical significance on diabetes control. Further statistical analysis of UDM group alone regarding age/sex, the results showed statistical significance with peak frequency for UDM among females (76.9%) existed in the age group 45-57 years. Further analysis of the UDM group alone according to work status and the educational levels in relation to age/sex relationship, the study categorized the patients into non-working (89.5%) illiterate female and working male (80.9%) had college education, the working status showed female predominate in nearly all age groups except at age group 32 - 44 years which showed solitary male predominance. The UDM among males showed inverse proportion relationship between age and the current work status while females showed direct proportion relationship between age and non-working status. The study showed high rates of obesity (53.2%) and the uncontrolled diabetes mellitus (UDM) scored 72.8% among the obese group ($p < 0.015$), the increased obesity rates resulted from the sedentary lifestyle and the availability of unhealthy Libyan diet. 76.8% of the study group presented with UDM reported defective dietary adherence ($p < 0.001$) also 85% of the study group were not adherent to the therapy and follow-up ($p < 0.001$) and 72.8% being on insulin therapy alone ($p < 0.015$). The percentage of patients with uncontrolled diabetes was higher than the controlled diabetes patients which was nearly comparable to that reported from many countries. The possible factors implicated for uncontrolled diabetes are high obesity rate, being non-working, woman aged ≥ 45 years, having either primary school education or illiterate female existed on (71 - 83) age group, followed by working man having college education aged between 32 - 44 years, lack of adherence to diabetes management which include the dietary and the therapeutic measures, lack of physical activity, patients on insulin therapy alone.

Keywords: Diabetes, uncontrolled diabetes mellitus, type 2 diabetes mellitus, fasting blood sugar, primary health care centers, Libya.

Introduction

Diabetes mellitus is a common disorder, serious, and progressive in nature. Good glycemic control can prevent or delay the complications associated with chronic hyperglycemia, such as long term dysfunction of various organs especially the eye, kidney, nerves, heart and blood vessels(1). The cardio-vascular complications that related to diabetes is considered as the leading cause of premature mortality and morbidity in diabetic population more than healthy people of the same age (2). Furthermore, it remains one of the major causes of vision loss and blindness in young adults despite the availability of effective treatment (3). Patients with diabetes have a 2- to 4-fold increase in the risk of both cardiovascular and cerebrovascular disease, and end stage renal failure in adult; also it is considered the major cause of non-traumatic limb amputation (4). Because patients with early T2DM are often asymptomatic, thus, as many as 25% of patients have already developed one or more micro-vascular complications by the time of diagnosis (5). In clinical practice, optimal glycemic control is difficult to obtain on a long-term basis due to complex factors both patients and health care giver play a role in them (6, 7). Studies like UKPDS6 (8) and DCCT7 (9) have proven that poor glycemic control (HbA_{1C} > 7%) is associated with increased risk for micro-vascular complications. Therefore, glycemic control is essential in diabetes management (10, 11). T2DM develops and progressively worsens over time, initially; an increase in insulin resistance and impairments in β-cell function and the incretin effect interact, over time resulting in a relative insulin deficiency as well as excessive glucagon production. So, first postprandial and then fasting blood glucose levels begin to rise (12-15). Hyperglycemia worsens all of the underlying patho-physiologic defects of T2DM, it is also an independent risk factor for macro-vascular disease, the risks of which begin to increase during the pre-diabetic phase (16-18), as well directly leads to the micro-vascular complications of diabetes (19-21). If patients are not able control their diabetes, even with appropriate treatment, factors associated with poorly controlled diabetes mellitus should be detected in order to offer possible solutions (23, 24). Glycemic control is determined by the interaction of genetic and environmental factors also known as risk factors, among which lifestyle plays a fundamental role (25-27). A risk factor is defined as a factor that is associated with a given outcome, but is not necessarily a cause (27). Risk factors affecting diabetes control including diet, physical activity, alcohol and tobacco consumption and drug compliance can be difficult to manage (23, 28-36). Research shows that the majority of patients with diabetes face challenges eating a healthy diet, exercising regularly and taking their medications (29-38). Furthermore, other factors including age, gender, race, insurance status, marital status, co-morbidities, duration of the diabetes and source of diabetes education (26, 39-41). Thus, the aim of this study is to review the proportion of controlled and uncontrolled diabetes among Libyan patients with type 2 diabetes mellitus (T2DM) depend on Fasting Blood Sugar (FBS) levels, and to identify the possible causes that may lead to poor glycemic control.

Materials and methods

Study design: descriptive, cross sectional study. Study setting: primary health care centers located in Tripoli city (Khalid Ibn Elwalid, Abo Miliana and Bab Ben Ghishir PHCs). Study period: from September to October 2015. Study population: after obtaining the authority approval from ministry of health and the patients consent, the study organized and the population were the patients attending the OPD for follow-up,

and from the total number of the PHCs (dispensary and polyclinics) working during the study period, three were selected by simple random sampling and from them 400 case of type 2 DM patients were selected by systematic random sampling according to the number of the patients attending each center. Study tool: pre structural questionnaire was used to collect the data from the selected patients during the interview. The questionnaire consist of personal data and information about Demographic data include age, sex, occupation, educational level (Illiterate, primary school, secondary school and college). Duration of diabetes (< one year, 1-4 years, 5-9 years, 10-19 years and > 20 years). Drug history of anti-hyperglycemic agent include oral hypoglycemic agents (OHAs), insulin and combined therapy. Adherence to the treatment and follow up in regular manner, Smoking, dietary consultation at time of diagnosis or later on or none, adherence to dietary regime (defined as low sugar and salt intake, high protein and low fat and carbohydrates intake). Exercise as exercising or not exercising, co-morbidity with diabetes, present complaint and any recurrent illness as a result of DM as ear, nose and throat problems, upper respiratory tract infections (URTI), gastroenteritis (GE), urinary tract infections (UTI), skin infection, diabetic foot, any psycho-emotional event within the last 6 months especially for first degree family, deaths and immigrants due to deranged and unstable political events in the country, family history of diabetes. Weight and height records for estimation of body mass index (BMI) which expressed as weight (kg)/height (m^2). The ranges of BMI values are classified into: normal weight (18.5 - < 24.5), over weight (25 - < 29.5), obesity (≥ 30). Fasting blood sugar level measurements, the study accepted 130 mg/dl as a cutoff value of the test to categorize the patients accordingly as controlled diabetes mellitus (CDM) and uncontrolled diabetes mellitus (UDM). Information and data obtained in the questionnaire considered as suspected factors leading to UDM and then subsequently evaluated against the a cutoff value of FBS level (130 mg/dl) and according to FBS reading the cases are categorized as patients had CDM in case FBS ≤ 130 mg/dl or patients had UDM when FBS > 130 mg/dl. The study considered FBS testing due to the availability of test, the cost issues and lack of HbA1c standardization in local laboratories.

Statistical analysis: the collected data were coded and analyzed by using SPSS software. Basic descriptive statistics were used to calculate mean and standard deviation of quantitative variables such as age, BMI, FBG and years with T2DM. Qualitative categorical variables such as gender, dietary consultation, adherence (drug diet and exercise), education level are reported as frequencies and percentages. Qualitative and quantitative variables were compared using the chi-square and Fisher test. $P < 0.05$ was considered statistically significant.

Results

Table 1 presented as the relationship or association between FBS value and selected factors leads to poor glycaemia control among T2DM patients.

Table 1: Distribution of personal characteristics according to diabetes control

Character	Controlled DMII	Uncontrolled DMII	Total	
Fasting Blood Glucose, n (%)	**133 (33.2%)**	**267 (66.8%)**	**400 (100%)**	**0.001**
Age group, *n (%)*				
19-31	**2(50%)**	**2 (50 %)**	**4(100%)**	**0.679**
32-44	**19(29%)**	**47(71 %)**	**66(100%)**	
45-57	**52(36.4%)**	**91(63.6 %)**	**143(100%)**	
58-70	**42(30.7%)**	**95(69.3 %)**	**137(100%)**	
71-83	**18(36 %)**	**32(64 %)**	**50(100%)**	
			100(100%)	
Sex, n (%)				
Male	**45(33.3%)**	**90(66.7%)**	**135(100%)**	
Female	**88(33.2%)**	**177(66.8%)**	**265(100%)**	**0.980**
			400(100)	
Duration of diabetes				
			34 (100%)	
Months- one year	**15 (44.1%)**	**19 (55.9%)**	**106(100%)**	
1-5years	**41 (38.7%)**	**65 (61.3%)**	**113(100%)**	**0.294**
5-10 years	**35 (31.0%)**	**78 (69.0%)**	**102(100%)**	
10-20 years	**29 (28.4%)**	**73 (71.6%)**	**45(100%)**	
>20 years	**13 (28.9 %)**	**32 (71.1%)**	**400(100%)**	
Education, n (%)				
Illiterate	**40 (38.1%)**	**65 (61.9%)**	**105 (100%)**	
Primary school	**47 (33.6%)**	**93 (66.4 %)**	**140 (100%)**	
Secondary school	**23 (36.5%)**	**23 (36.5%)**	**63(100%)**	
Collage	**23 (25.0 %)**	**23 (25.0%)**	**92(100%)**	**0.237**
			400(100%)	
Occupation				
Working	**48(31.4%)**	**105(68.6%)**	**153 (100)**	
Not working	**85(34.4%)**	**162(65.6%)**	**247(100%)**	**0.530**
Drug H/O hypoglycemic agent n (%)				
Oral	**67(40.1%)**	**100 (59.9%)**	**167(100%)**	
Insulin	**26 (26.5%)**	**72(73.5%)**	**98(100%)**	**0.042**
Combined	**40 (29.6%)**	**95 (70.4%)**	**135(100%)**	
			400(100%)	
Adherence to treatment & followup n (%)				
Adherent	**116 (40.7%)**	**169 (59.3%)**	**285(100%)**	
Not adherent	**17 (14.8%)**	**98(85.2%)**	**115 (100%)**	**0.0001**
			400(100%)	
Diet consultation n (%)			**49(100%)**	
at diagnosis	**19 (38.8%)**	**30 (61.2 %)**	**50(100%)**	
at any time after diagnosis	**17 (34.0%)**	**33 (66.0%)**	**301(100%)**	**0.661**
None	**97 (32.2%)**	**204 (67.8%)**	**400(100%)**	

Dietary adherence n (%) **Adherent** **Not adherent**	**70 (54.3%)** **63 (23.3%)**	**59 (45.3** **208 (76.8**	**129** **271**	**0.0001**
Causes of non-dietary adherence n (%) **Non-compliance to diet** **Low socioeconomic state** **Non-specific causes**	**10(20.8%)** **0(0%)** **53 (25.1%)**	**38(79.2%)** **12(100%)** **158(74.9%)**	**48** **12** **211**	**0.122**
Smoking n (%) **Smoker** **Non smoker** **Ex-smoker < 5 years duration of smoking abstained**	**18 (33.3%)** **112 (33.8%)** **3 (20.0%)**	**36 (66.7%)** **219(66.2 %)** **3 (20.0%)**	**54 (100%)** **331(100%)** **15(100%)** **400(100%)**	**0.538**
Exercising n (%) **Exercising** **Not Exercising**	**71 (36.8%)** **62 (30.0%)**	**122 (63.2%)** **145 (70.0%)**	**193** **207**	**0.147**
Causes of Not exercising n (%) **Laziness** **Aging** **Others**	**16(21.9%)** **13(48.1%)** **33 (30.0%)**	**57 (78.1%)** **14 (51.9%)** **145 (70.0%)**	**73** **27** **107**	**0.038**
Any psycho-Emotional event n (%) **yes** **no**	**70 (30.8%)** **63 (36.4%)**	**157 (69.2%)** **110 (63.6%)**	**227 (100%)** **173 (100%)**	**0.284**
Family history of DMII **Yes** **No**	**83 (30.3%)** **50 (39.7%)**	**191 (69.7%)** **76 (60.3%)**	**274(100%)** **126 (100%**	**0.064**
BMI **Normal** **Over-weight** **Obese**	**32 (44.4%)** **43 (37.8%)** **98 (27.2%)**	**40(55.6%)** **72(62.2%)** **155(72.8%)**	**72(100%)** **115 (100%)** **213(100%)**	**0.015**
Associated co-morbidity **Hypertension** **Dyslipidemia** **Hypothyroidism** **Steroid Therapy** **Arthropathy**	**69(32%)** **61(33.3%)** **6 (21.4%)** **7(29.2%)** **57(29.5%)**	**146(67.9%)** **122(66.7%)** **22(78.6%)** **17 (70.8%)** **136(70.5%)**	**215(100%)** **183(100%)** **28(100%)** **24(100%)** **193(100%)**	**0.33** **0.529** **0.119** **0.424** **0.078**

Associated Recurrent infection				
Skin infection	**2 (14.3%)**	**12(85.7%)**	**14(4.5%)**	
Ear Nasal Throat	**8(23.5%)**	**26(76.50%**	**34(8.5%)**	
Upper Respiratory Infection	**8(34.8%)**	**15(65.20%)**	**23(5.8%)**	
Gastroenteritis	**14(27.5%)**	**37(72.5%)**	**51(12.8%)**	**0.238**
Urinary Tract Infection	**13(32.5%)**	**27(67.5%)**	**40(3.5%)**	
Arthritis	**4(22.2%)**	**14(77.8%)**	**18(4.5%)**	
Diabetic foot	**1(16.7%)**	**5(83.3%)**	**6(1.5%)**	
Non-specific	**83(38.8%)**	**131(61.2%)**	**214(53.5%)**	

Fasting blood sugar distribution, the mean FBS was 168.54 ± 70.545 mg/dl and considered statistically significant ($p < 0.0001$).

Age distribution, age distribution of the patients interviewed in this study ranged between 19-80 years, with mean age of 56.2 ± 11.5 years and the mode is 48 years, the glycemic control was lost among the vast majority of the different age groups and the peak frequency of UDM verses CDM were most evident among 32-44 years where 71% (47 out of 66) patients of the corresponding age had UDM . The results did not show statistical significance ($p < 0.679$).

Gender difference, it is showed that the female gender had UDM slightly more than males (66.8% verses 66,7%) and considered statistically insignificant ($p < 0.980$). However, with further analysis of uncontrolled group in respect to their age group and sex the study found that the female patients in age group (45-57 years) had the highest frequency of UDM accounted 76.9% (70 out of 91) patients of the corresponding age & gender group ($p < 0.015$).

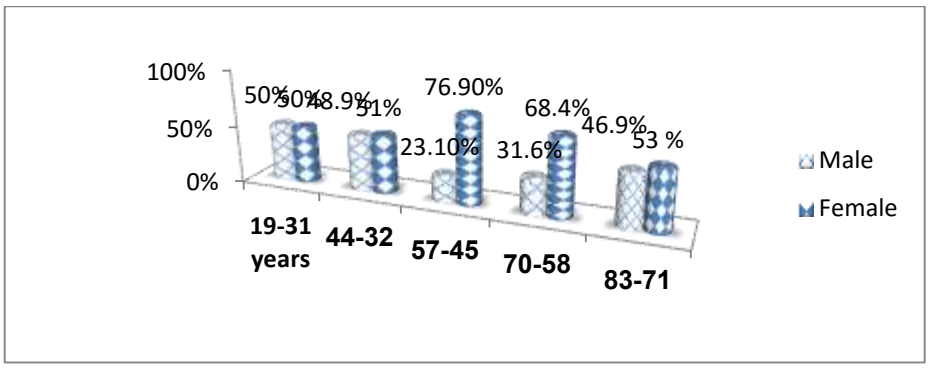

Figure 1: The glycemic control disparity according to age and gender distribution of diabetic patients

Duration of diabetes distribution showed that the highest percentage of UDM according to duration of diabetes was among patients had diabetes for 10-19 years and recorded 71.6% (73 out of 102 patients), the results considered statistically insignificant ($p < 0.294$).

Educational levels distribution, the study demonstrated that the highest percentage of UDM verses CDM was among patients had attained the college education and scored 75% (69 out of 92 patients), UDM according to education levels and gender considered statistically significance ($p < 0.0001$) and showed highest frequency of UDM among males attained college education 55.1% while the females in the same group scored 44.9% and considered the lowest frequency among females in the study, the results reversed among the illiterate group, the illiterate females scored

the highest frequency of UDM 92.3% and the illiterate males recorded the lowest frequency among males in the study.

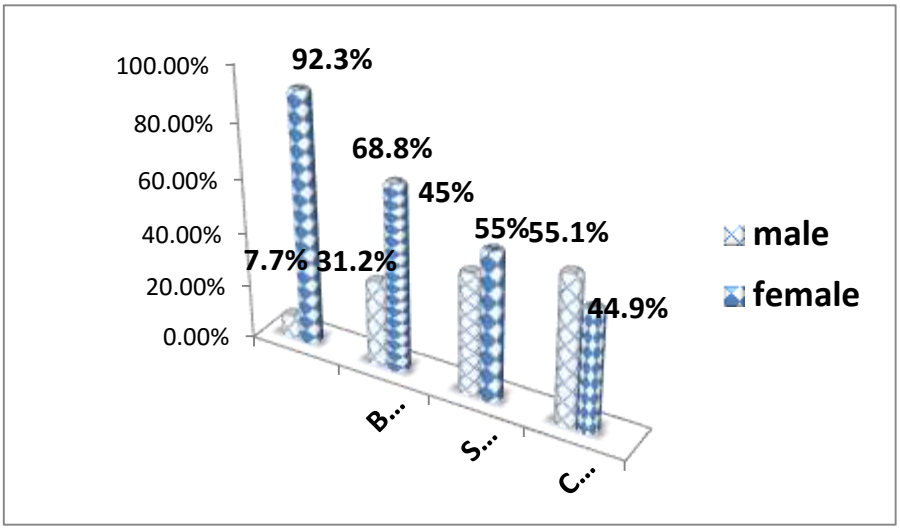

Figure 2: UDM verses Education & gender among diabetic patients

Occupational distribution, the frequency of UDM was higher among the working group and account 68.6% (105 out of 153) versus 65.6% (162 out of 247) non-working group. Further analysis of the uncontrolled group a significant relation was detected when the glycemic control distributed against sex and the current working status, the study noticed that UDM had female predominance among the non-working group accounted 75.1% (133 out of 177) and male predominance in working group scored 67.8% of male patients had UDM (61 out of 90). The results considered statistically significant ($p < 0.001$), the same statistical significance ($p < 0.001$) observed with further analysis of the uncontrolled group alone in respect to occupation and age where UDM recorded in almost all nonworking group starting from age group 45-57 years in direct proportional manner with age and the current work and the peak frequency of UDM scored 87.5% (28-32) at (71-83) years of the corresponding age group whereas the peak frequency of UDM among the working group existed at the age group (32-44 years) and account 80.90% (38 out of 47) patients in inverse proportion relationship with age and the current work status.

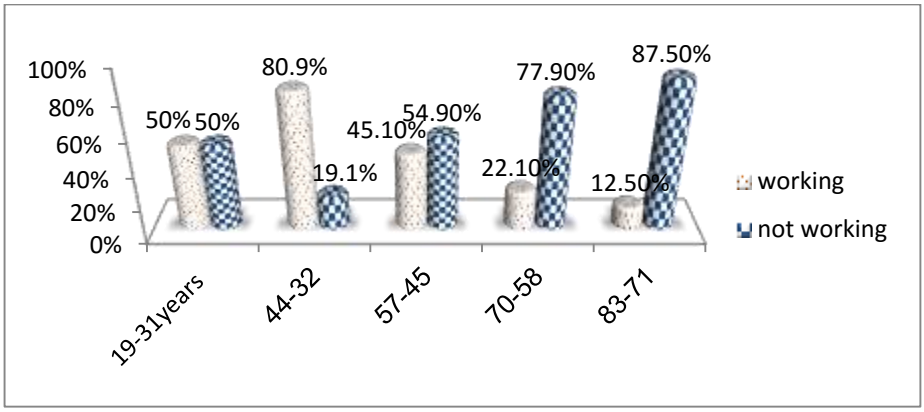

Figure 3: Distribution of UDM according to occupation and age

Drug history of anti-hyperglycemic agents, in the study group showed that 41.8% (167 out of 400) diabetic patients treated with oral hypoglycemic agents (OHAs) and in cross tabulation of glycemic control and drug history of anti-hyperglycemic therapy, demonstrated that the patients receiving insulin therapy had the highest frequency of UDM and patients on OHAs had lowest frequency of UDM . The results considered statistically significant ($p < 0.042$).

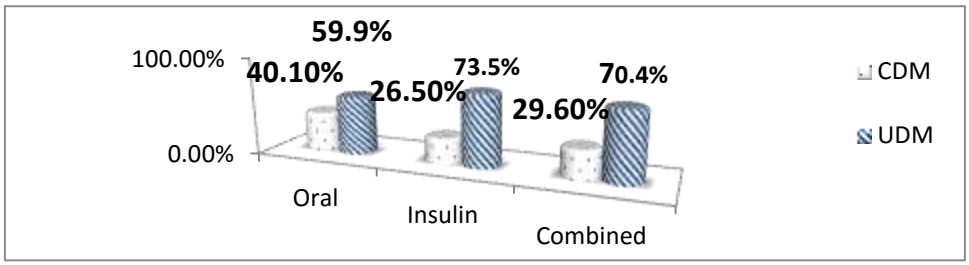

Figure 4: Distribution of glycemic control according to drug history of anti-diabetic therapy

Adherence to treatment and follow-up among the study group showed 71.2% (285 out of 400) patients were adherent, in cross-tabulation of the glycemic control with the adherence to the therapy and follow –up (figure 6) revealed that 59.3% (169 out of 285) of adherent patients had UDM, while 85.2% (98 out of115) of non-adherent patients had UDM. The results considered statistically significant ($p < 0.0001$).

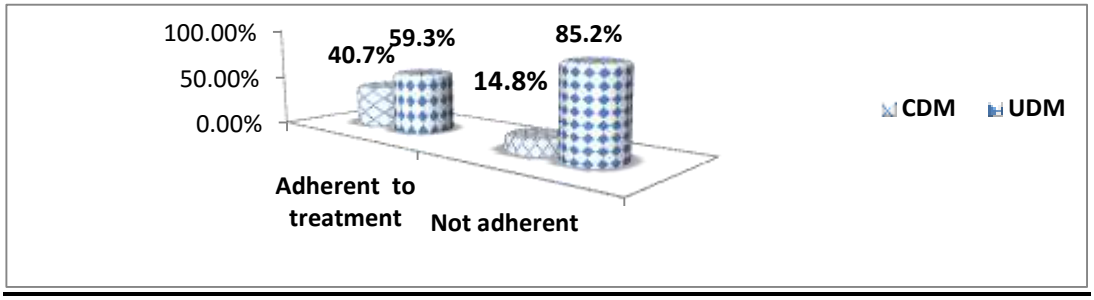

Figure 5: The relationship between glycemic control and adherence to treatment and follow up

Dietary consultations distribution showed 75.2% (301 out of 400 patients) did not have dietary consultations and 67.8% (204 out of 301) of patients had UDM did not receive any dietary consultation while 63.6% (63 out of 99) had UDM despite dietary consultation advices. The results did not show statistical significance ($p < 0.448$).

Dietary adherence distribution showed that 67.8% (271 out of 400) were not adherent to the diet, and 32.2% (129 out of 400) were adherent to the diet. Study showed that 208 out of 271 non-dietary adherent patients (76.8%) had UDM while 59 out of 129 adherent patients (45.3%) had UDM. The results statistically significant ($p < 0.001$).

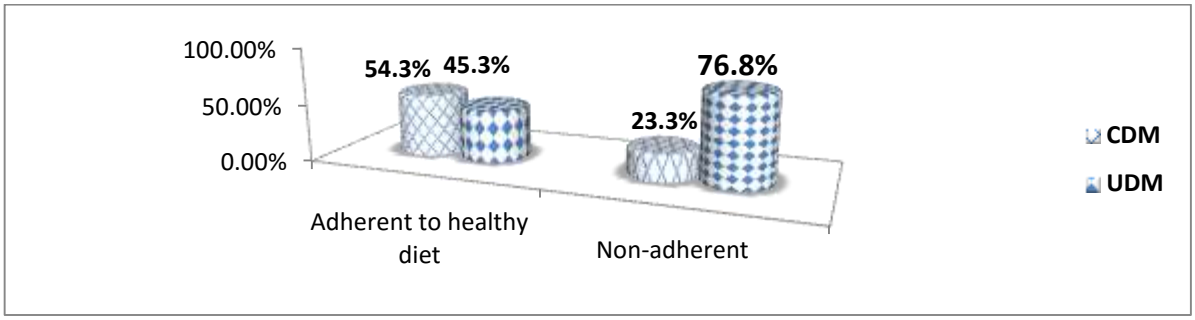

Figure 6: Dietary adherence distribution of UDM verses CDM in diabetic patients

Smoking distribution showed that 331(82.8%) were non-smoker patients, all smokers and the ex-smokers were males. The study demonstrated that the highest percentage of UDM according to smoking distribution (figure 8) was among the ex-smoker patients and recorded 80% (12 out of 15 patients), p was considered statistically insignificant ($p < 0.538$) but cross-tabulation of smoking and gender with the investigated glycemic control the results were statistically significant ($p < 0.0001$).

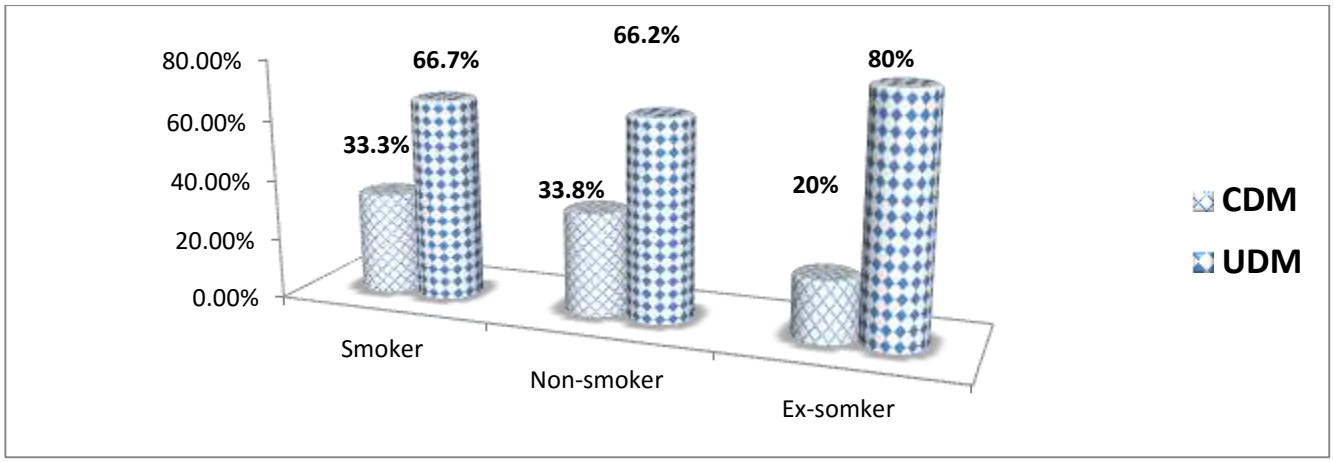

Figure 7: Smoking distribution in diabetic patients according to glycemic control

Exercise distribution among the studied group showed that the glycemic control was lost in both groups, 122 (63.2%) out of 400 were exercising had UDM and 145 (70%) out of 400 were not exercising and presented with UDM. The results did not show statistical significance ($p < 0.661$).

Causes of non-exercising among the study group attributed to laziness 18.2% (73 out of 207), aging 6.8% (27 patients) and other non- specific causes accounted 26.8% (107 out of 207). The other causes for non-exercising according to the patients point view mainly related to unsafe environment and the associated chronic disease as gartheropathy. The glycemic control was lost among the non-exercising group (figure 11) and the peak frequency of UDM recorded among patients presented with laziness and scored 78.1% (57 out of 73), causes of non-exercising was statistically significant ($p < 0.038$).

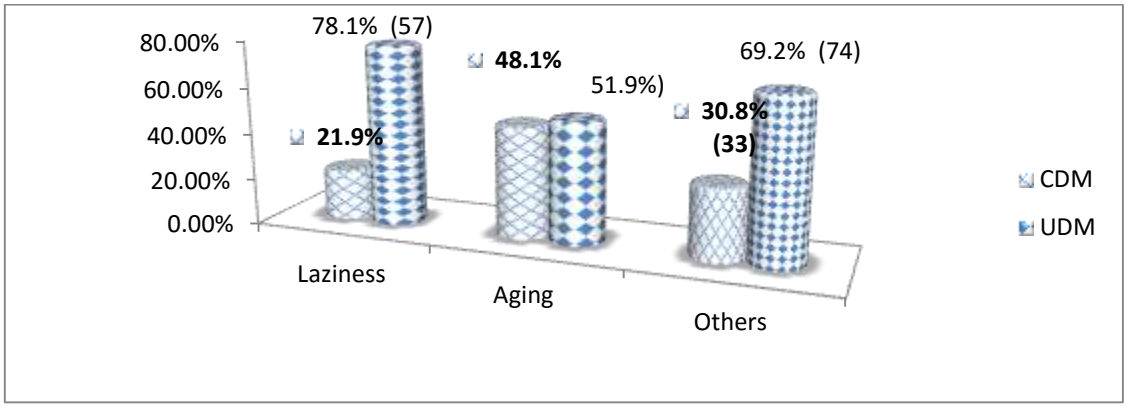

Figure 8: Distribution of the Causes of UDM among non- exercising population

Psycho-motional events distribution of the study group composed of 56.8% of the patients (227 out of 400) reported psycho-motion derangements, the study demonstrated that the percentage of UDM verses CDM was higher among patients had psycho-motion derangement and scored 69.2% (157 out of 227), $p < 0.241$. In cross-tubulation of psycho-motional events and gender with glycemic control levels (figure 14), the results demonstrated that the females had more UDM in association with psycho-motion derangements and showed statistical significance ($p < 0.0001$).

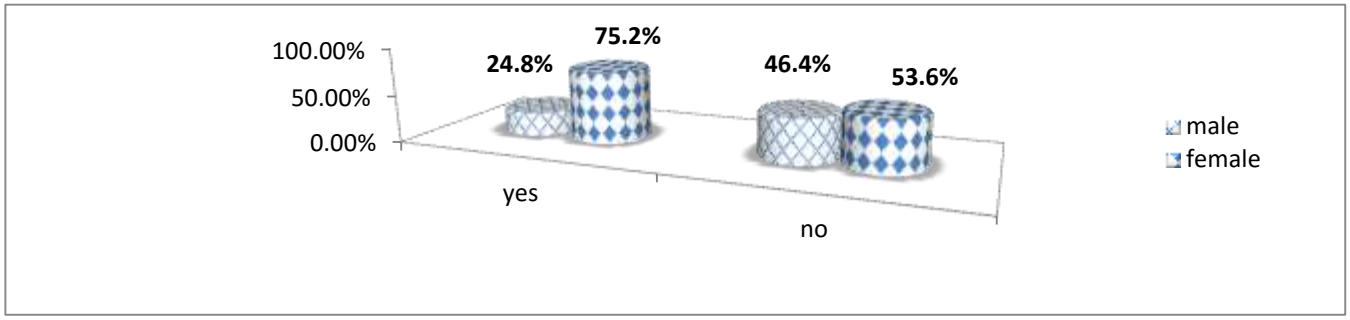

Figure 9: cross tabulation of psycho-motion and gender with the glycemic control

Family history distribution showed that 68.5% (274 out of 400) patients had positive family history for diabetes, in cross-tabulation of the glycemic control with family history distribution (figure15) revealed that 69.7% (191 out of 274) of the patients had UDM, while 60.3 % (76 out of 126) of the patients had UDM. The results did not show statistical significance ($p < 0.064$).

Body mass index distribution showed that the mean weight was 78.81 $\pm$ 1.53 kg and the mode was 70 kg while the mean height was 1.61 $\pm$ 0.07 m and the mode was 1.60 m, regardless of the age and gender.

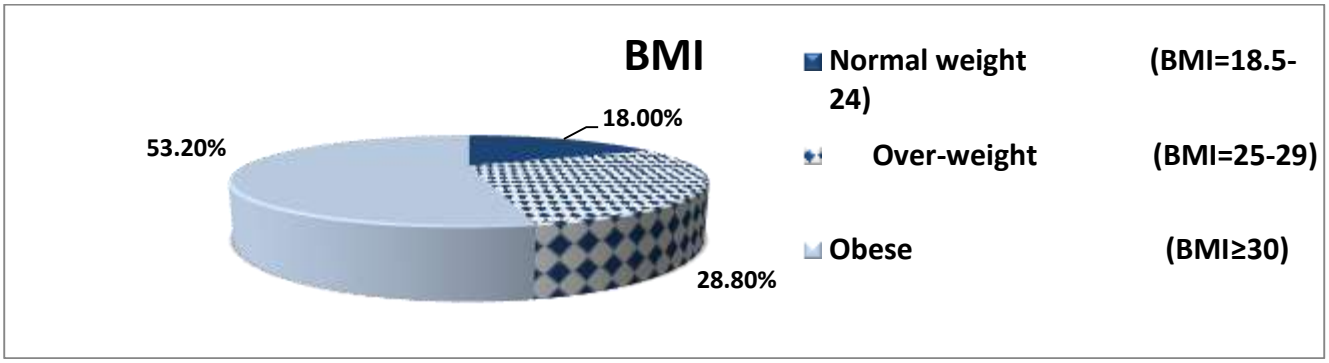

Figure 10: Obesity Distribution according to BMI of diabetic patients

Glycemic control and obesity, the study showed that UDM were more evident among the obesity group and scored 72.8% (155 out of 213) followed by overweight group 62.6% (72 out of 115) and patients with normal body weight recorded 55.6% (40 out of 72). The results were statistically significant ($p < 0.015$).

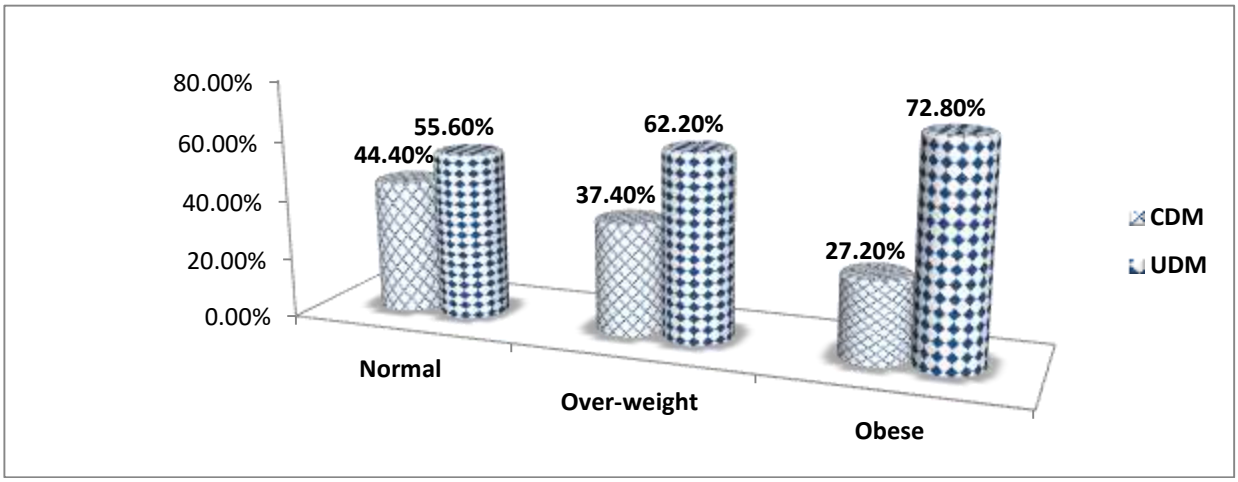

Figure 11: Glycemic control and BMI distribution of diabetic patients

Co-morbidity distribution showed that hypertension was most common among the study group followed by artheropathy, in cross tabulation of UDM and hypertension with the duration of diabetes (figure 12), the results showed statistical significance ($p < 0.004$), the peak frequency of reported hypertension seen in patients had diabetes duration of (10-19 years) and recorded 33.6% (49 out of 146) patients. With tracing UDM among the group revealed that patients with Hypothyroidism had the highest frequency of UDM (78.6%, $p < 0.119$), all results of the associated co-morbidity were statistically insignificant .

Recurrent infection and the main complaint distribution in the study group showed that 53.5% (214 out of 400 patients) had no specific illness, and UDM were more evident among patients had skin infections and scored 85.7% (12 out of 14 patients). The results were statistically not significant ($p < 0.238$).

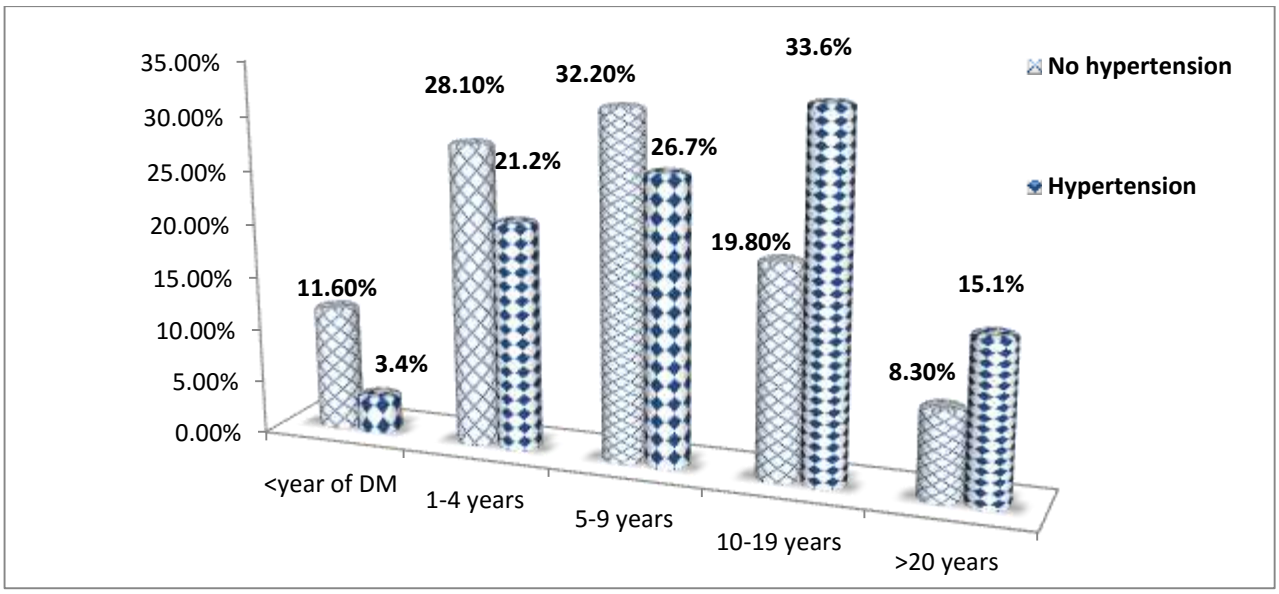

Figure 12: Cross- tabulation of UDM with hypertension and duration of diabetes

Discussion

American Diabetic Association (ADA) defined the poorly controlled diabetes as having a (HbA1c) of > 7%, pre-prandial capillary plasma glucose > 130 mg/dl and peak postprandial capillary plasma glucose of > 180 mg/dl (42). The study considered FBS testing for the investigated patients due to lack of HbA1c standardization in the local laboratories and according to evidence based medicine practice guidelines applications in the Libyan medical society, the study accepted 130 mg/dl as a cutoff value of the test to categorize the patients accordingly as controlled verses uncontrolled diabetes mellitus (42). The present study showed that out of 400 diabetic Libyan patients investigated for FBS 133 patients (33.2%) had CDM versus 267 patients (66.8%) presented with UDM, this issue indicated that the glycemic control among diabetic patients in the primary health clinics was not achieved in most patients, Low levels of glycemic control has been similarly shown in other studies done in Malaysia (43), Jordan (44) and in other developing countries. Poor glycemic control (HbA1c > 7%) was present in 65.1% of patients in Jordan according to Khattaba et al. (44). In Kuwait, Al-Sultan and Al-Zanki reported that 66.7% of the studied population had HbA1c ≥ 8% (45). In Saudi Arabia, Akbar stated that only 27% of the patients reached target level of glycemic control (46). In Pakistan, Habib and Aslam had found 46.7% of patients had HbA1c > 7.5% (47). Furthermore, HbA1c reported from National Health and Nutrition Examination Survey III was > 9% in 24.5% of patients (48). In UK, 69% had HbA1c > 7.5% had reported by Fox and other on 2006 (49). Most studies done on Type 2 diabetes focused on one specific factor such as depression which studied by katon and others

(50), or race and its effects on glucose control conducted (8). Libyan population composed of mixed ethnicity groups and difficult to assess the actual race according to characteristics of the individual phenotype to prove that race may influence the glycemic control, also the type the present study (cross sectional design) not suitable for assessment and evaluation of major depression diagnosis and its role in development of UDM, the later issue based on the psychiatrist's opinion. Many Studies conducted during the last decade have concentrated and reported on the prevalence of 'uncontrolled' type 2 DM and the results of the studies found evidence of factors responsible for poor control of diabetes but the primary objective in many well-conducted studies was not the factors responsible for poor control of diabetes, Hence, this area requires more attention of diabetes researchers (51-56). The present study tried to estimate the prevalence of (UDM) in Libyan society and to identify and evaluate multiple factors leading to UDM as one of the primary objectives of the study. Although the results of UDM in relation to age considered statistically insignificant, similar results obtained by Khattaba's study (44) which reported the lack of relationship between age and poor glycemic control, and observed that the highest percentage of UDM had seen among patients aged 50-59 years and accounted 66.3%(207 out of 312 patients) in contrast to the present study which recorded highest percentage of UDM had seen among patients aged 30-39 years of age which considered younger age group in the study population and accounted 76% (19 out of 25). Similar relationship between the young age and poor glycemic control among patients with T2D was observed in a number of studies which reported that the younger patients with type 2 diabetes need better glycemic control, EL-Kebbi et al. studied the association of younger age with poor glycemic control and documented that younger patients were more obese than older patients, and expected to have more insulin resistant, and possibly require more aggressive therapy to achieve glycemic control (57), Nichols et al studied the predictors of glycemic control in insulin using adult with T2D and similarly concluded that younger age and increased emotional distress about diabetes were all significant predictors of worse glycemic control (58). The previously mentioned studies documented also that younger adults may have difficulty attending clinic appointments and the supposed self-care activities, in addition to their over work and family responsibilities; they may also be more affected by rapid changes in lifestyle as reflected by obesity pattern, an indicator of dietary pattern and physical activity (59).

Although female gender in the present study was predominant and accounted 66.2% versus 33.8% male patients, the results of UDM in relation to the gender in the study group showed that the male patients slightly had better glycemic control than females (66.7% versus 66.8%, male to female ratio respectively), the results showed a similarity with Sanal et al. meta-analysis which demonstrated that the elderly male patients (> 60 years) having normal BMI patients had better control on diabetes. And the same study concluded that the younger diabetic patients did not care about the disease control and the females take the disease only as a second priority as compared to males (60). Similar results reported by Khattaba et al. study which documented that males had better glycemic control and the UDM among the male versus female group accounted 63.4% versus 67.1%, respectively. The results regarding UDM and gender in the present study did not show statistical significance similar to that reported by Khattaba et al. study. The study showed that diabetes was more common among patient had restricted educational level to the basic teaching school with peak frequency of diabetes was 35% then followed by illiterate diabetic patients in the study group that recorded 26.2%. The UDM more evident in the mentioned groups, with female predominance in almost all educational level except at the college level where the male gender showed higher frequency of UDM and

the illiterate male patient had the lowest frequency rate of UDM. The possibility of defective diabetes knowledge among highly educated male patients might be considered as a pitfall in their education, in contrast to the illiterate male whom acknowledge their defective educational shortness and seek the best advices regarding their sickness so that they modify and upgrade their knowledge about diabetes .this just point of view and should be traced and investigated in forward researches in order to upgrade the ongoing daily practice. Controversial results obtained by Elkharam et al. study which stated that diabetes knowledge and adherence to health advice among Adults with diabetes in Libya is very poor especially among females and those classed as illiterate within the study (61). In contrast to the present study, the better glycemic control seen in Japan and Germany might be because of the higher literacy rate in developed countries, and consequently better knowledge about the disease (62, 63). Obesity and T2DM are chronic conditions and both of them need long-term management strategies. Obesity is defined as excess body fat and now recognized as a disease in its own right (64). WHO observed that 80–90% of people diagnosed with DMT2 also diagnosed obese as well (65, 66). Obesity is a global epidemic resulting in major morbidity and premature death. Elmehdawi and Albarsha (67) stated that 64% of Libyan adults are either overweight or obese, obesity progressively increasing with age and two times more common among Libyan women than men (67). The present study observed strong relationship between obesity and diabetes, the results showed a similarity with Mohsen's study which documented that the incidence of obesity was higher in people with diabetes (68). The present study recorded 53% and ~29% of the studied group had obesity and overweight respectively and UDM among them as 72% and 62% respectively, the result showed statistical significance between UDM and BMI and similarity with Khattaba's study that found 69.5% of the obese patients had poor glycemic control and the obtained for their BMI results (44). The prevalence of obesity has been increasing worldwide and now considered a common problem resulting from a sedentary lifestyle that includes excessive television viewing, insufficient physical activity and the high consumption of fatty foods. The present study did not reported significant association between UDM and exercising although the causes of defective exercise showed statistical significance. Several Studies demonstrated that numerous factors affecting the attitude to exercising in diabetic patients include physical factors (69, 70) such as age, sex and BMI; psychosocial factors (71) and life-related environmental factors (72, 73). In a previous study done in Libya, Etobgi reported that Libya has the highest prevalence of T2DM in North Africa and in the Arab world. he reported that Type 2 diabetes affected > 70% of Libyan adult population and the most possible cause is eating habit (74), similar results obtained in Malaysia by Eid et al. that among the reasons have been suggested for the poor glycemic control are a local diet that is high in carbohydrates, a lack of physical activity and a lack of knowledge about diabetes and its treatment (75). In short, the present study indicate significant association between UDM and defective exercising and the high obesity rates among most of diabetic Libyan patients, these finding were considered as modifiable risk factors in UDM populations that targeted to improve the glycemic control. Despite the importance of diet and exercise in control of diabetes, only a small percentage of T2D patients were adherent to diet and exercise regimes. The barriers to exercise in the study group are attributed mainly to unsafe environment during the last 5 years, existing chronic diseases mainly artheropathy, old age, laziness and lack of time. Regarding duration of diabetes the study showed the longer duration of diabetes was associated significantly with poor glycemic control. The control lost progressively with time and the highest percentage of UDM existing among patients had 10-19 years duration of diabetes. This finding is consistent with that reported

by Khattaba (44) and other studies (76-78), the possible reasons for the deranged glycemic control attributed mainly to progressive impairment of insulin secretion with time due to β-cell failure, which makes the response to diet alone or oral agents unlikely as proved by UKPDS study group (79). The relation between duration of diabetes and exercise had previously reported to be a factor in determining the level of glycemic control (80-83). Tong's study also proved that patients with longer duration of diabetes and more complex treatment regimens were associated with poorer glycemic control (48). Thus, as the disease progresses, most patients require an increase in their pharmacotherapy to maintain glycemic control (85). Regarding drug history of anti-diabetic agents history, the present study showed statistical significance , the best glycemic control was achieved by patients on oral hypoglycemic agents (OHAs), followed by those on a combination of OHAs and Insulin. Patients receiving insulin therapy alone had the highest score of UDM compared with those receiving OHAs or a combination of OHAs and insulin. In Libya both sulphonylureas and metformin are widely used as first-line hypoglycemic therapy and the popularity of sulphonylureas has decreased, and metformin is now a more common choice. However, Cook's study showed that more than 80% of patients do not consistently maintain HbA1c control 2 years after initial monotherapy with metformin or sulphonylureas (86). And patients who treated by combination therapy of OHAS and insulin had more progressive disease and over time required more aggressive management to achieve the glycemic control, this finding reflects the fact that diabetes deteriorations over time, and the need for higher doses or additional medications increases subseq-uently. Additional causes of deranged glycemic control in patients treated by combination therapy attributed mainly to factors that affecting the proper timing of insulin initiation in treatment regimens these factors include fear of the patients from the injection, inappropriate dosing, frequent hypoglycemic attacks, defective insurance that affecting the availability of the medications, shortness of insulin in public pharmacy, defective knowledge of some healthcare providers for the different kinds of insulin preparations that mandate individ-ualization of the therapy for the different patients. In this study the adherence to treatment and follow upshowed statistical significance, poor glycemic control in the study group more common among patients who were not adherent for medications. Therefore, patients should be motivated to use the medications as prescribed. Patients managed with a combination treatment of OHAs and insulin requires more aggressive treatment and monitoring, both in terms of adequate dosing and improved adherence, to achieve better outcomes. Studies showed that the effectiveness of drug treatment depends primarily on the efficacy of the prescribed treatment and adherence of the patient to the treatment (87). The task of non-adherence is not a simple matter and difficult to evaluate, as it is multi-factorial and might include cost, health belief, dosing frequency, personality disorders and patient–provider relationship (88). In this study psycho-emotional events did not illustrate statistical significance with UDM, whereas, the results of the other clinical trials has controversial issues (89-92). Smoking is common among diabetic patients as in the general population and show male gender predominance in the study group, smoking greatly amplifies macro-vascular risk in diabetic subjects (the 10-year mortality rate mainly from myocardial infarction is about 50% higher than in diabetic non-smokers and twice as high as in non-diabetic non-smokers) and accelerate the progression of nephropathy and retinopathy.

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