Research Article

Type 2 Diabetes and Comorbidity Among Internal Medicine Lebanese Patients: A Case Control Study

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ABSTRACT

Introduction: Comorbidity has been shown to increase length of stay (LOS), and mortality in diabetic patients. However, in Lebanon there is no data that studies the impact of comorbidity on mortality. Our aim was to assess whether comorbid conditions affect LOS and mortality in the sample under study.

Study Design and Setting: A case-control retrospective pilot study was undertaken using data of patients admitted to Rafik Hariri University Hospital for six months. Comorbidity information was collected using Charlson Comorbidity Index (CCI), and Cumulative Illness Rating Scale (CIRS). Bivariate and multivariate analyses were conducted.

Results: We studied 361 patients (33.2% were diabetic). In comparison to non-diabetic patients, diabetic patients had more comorbidity (5.28 *vs* 4.04; p <0.001), which was assessed by CIRS (p <0.001) and CCI (p <0.001). Non-diabetic patients have three times more risk of mortality than diabetic subjects, but the mean LOS for patients with diabetes was one day longer than patients without diabetes.

Conclusion: These results showed that comorbidity increased both mortality and LOS, and it suggested that controlling diabetes and comorbidities may reduce mortality and LOS. However, they need to be confirmed by further investigations in a larger sample.

Introduction

Diabetes is one of the most prevalent chronic diseases. The estimated prevalence of diabetes in the world population was 6.6% in year 2012 and this number is projected to increase to 7.8% by 2030 [1]. According to the International Diabetes Federation the projected prevalence of type 2 Diabetes Mellitus (DM) among adults in Lebanon for year 2020 is 20.4% [1]. Comorbidity occurs frequently among patients with diabetes [2, 3]. Indeed, comorbidities are diseases or disorders that coexist with a disease of interest which causes a delay in the diagnosis, influence treatment decision, alter the incidence of complications, and confound all analysis [4]. Measuring these comorbidities is important; Alvain Feinstein noted that "the failure to classify and analyze comorbid diseases has led to many difficulties in medical statistics", because comorbidity affected the moment of detection, prognosis, outcome and

the treatment decision [5-7]. So far, thirteen different methods to assess comorbidity have been identified [8]. Patient with diabetes had a higher number of comorbidities with a mean of 2.6 for diabetic patients with any diagnosis and 2.4 for diabetic patient as a principle diagnosis compared to 1.3 for patients without diabetes [9].

For diabetes, some associated comorbidities were positively related to the length of stay (LOS) in hospital [9, 10]. The mean LOS for patients with diabetes was almost one day longer than for patients without diabetes (5.3 *vs* 4.4 days) [9]. Also, people with diabetes have higher all-cause mortality rates than similar people without diabetes, mainly attributed to cardiovascular causes [11-13]. Many countries (including Lebanon) lack epidemiological studies that permit surveillance of diabetes associated morbidity and comorbidity. To study these associations, we conducted a retrospective study with the objective to

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understand whether diabetes or its associated comorbidity affected the LOS and mortality in hospitalized patients.

Materials and Methods

I Data sources and patients selection

We undertook a retrospective pilot study of consecutive patients recruited to the internal medicine ward over a period of 6 months to Rafik Hariri University Hospital (a public tertiary care center), between November 2012 and April 2013. This ward was selected since admitted patients were mostly elderly; they had multiple co-morbidities which usually included chronic rather than acute diseases. This study was approved by Institutional Review Board.

During this period, 553 patients were admitted to the ward, 361 were selected (65.3%), while 192 (34.7%) were excluded for the following reasons: non-Lebanese patients, patient with only one disease (no comorbidity), patient with comorbidity but the index disease is not a chronic one, other types of diabetes rather than type 2 DM (type 1 DM and gestational diabetes), and absent data on past medical history. Patients were included if they were admitted for type 2 DM, if the patients have comorbid conditions (related or not to diabetes), or if they were admitted for at least one chronic disease with comorbidities. Second, all enrolled subjects were divided into two groups in relation to the presence/absence of diabetes (case/control).

II Data collection and clinical parameters

Patients' medical and medication history was collected on standardized clinical form. Sociodemographic data, the chief complaint, final diagnosis, the LOS, and status of discharge (alive or dead) were also collected. At the time of admission, laboratory results were collected: glycosylated hemoglobin (HbA1c), glycemia, renal and liver function tests, lipid panel, in addition to blood pressure measurement.

III Outcome definitions

Two outcomes were assessed: mortality rate and the length of hospitalization.

IV Comorbidity scores

The number and the severity of comorbid diseases were collected using standardized methods and forms. Comorbidities were assessed by two comorbidity scores: Charlson comorbidity index (CCI) and Cumulative Illness Rating Scale (CIRS); both scores were filled from medical charts. These two scores were valid and reliable methods to measure comorbidity that can be used in clinical research [14-16]. CIRS is a valid instrument in younger and elderly patients [17]. It is a multi-item summative predictive index that differentiates between 14 organ systems. Every comorbidity of a patient was assigned to one of the organ systems and rated from 1 (mild) to 4 (extremely severe). A patient can score from 0-56. The index is reported as a continuous variable that usually follows a normal distribution, skewed slightly to the right [15, 18].

CCI is the most extensively studied comorbidity index [16]. It includes

20 items and the conditions are defined from 1-6 [15]. It is a summative scale, and yields a continuous variable from 0 to 33 [15]. The scores are relatively skewed to the right, because most of the patients have a score of zero [15, 18]. To avoid any effect of diabetes status on the comorbidity score, a modified score was generated for each used score where the diabetic status was abstracted from the scores (CIRS-noDM, and CCI-noDM). The data collected for each score was checked and reviewed by the main investigator to ensure quality.

V Statistical analysis

Data were analyzed using Statistical Package for Social Sciences (SPSS 21) software. First, descriptive statistics were used to describe the patients' characteristics and outcomes, results were shown as mean and standard deviation for continuous variables, and as percentage for categorical variables. Pearson Chi-squared test was used for comparing categorical variables between groups; when expected values within cells were <5, Fisher exact test was used. For quantitative variables with normal distribution, Student t-test and ANOVA were used to compare between two and multiple groups, respectively, in case of homogeneous variances. For continuous variables Pearson correlation test was used. The association between diabetes and LOS was evaluated using a multiple linear regression, after ensuring residuals normality, which included DM variable, CCI-noDM and CIRS-noDM as covariates, Cox regression model was used with time to death as the dependent variable, considering the hazard ratio (HR), to estimate the effect of diabetes on mortality using the same covariates. Forward logistic regression was conducted to check for the association of diabetes (dependent variable) and comorbidities. In all analyses, a p-value <0.05 was considered significant.

Results

I Case-control baseline characteristics

The present analysis included 361 patients for whom full data were available for the variables under study: mean age 64.94 ± 13.7 years; 50.4% were women, and 51% were smokers. A diagnosis of type II DM was made in 120 (33.2%) of those patients. The diabetic patients were considered to be the cases while the 241 non-diabetic patients (66.8%) represented the controls. The mean LOS in the hospital was 15.58 days, with no significant difference between the two groups (16.17 days for diabetic patients, and 15.28 days for non-diabetics, p-value: 0.567). The patients that were dead during hospitalization represented 12.7% of the whole population, where non-diabetic patients score highest mortality rate compared to the cases (14.9% *vs* 8.3% respectively, p-value: 0.051).

Patients' sociodemographic and baseline characteristics are presented in Table 1. Concerning home medications, significant difference was detected between cases and controls relative to the usage β-blocker as antihypertensive agents (45.8% *vs* 29% respectively; p-value: 0.002). With respect to the laboratory results, there was a statistically significant difference between cases and controls concerning: aspartate aminotransferase was lower for diabetics (25.27 ± 18.09 *vs* 39.50 ± 61.10 respectively, p-value: 0.002), while triglycerides were higher (160.04 ± 90.24 *vs* 135.99 ± 71.81, p-value: 0.043).

Table 1: Baseline characteristics of patients enrolled in the study.

Characteristics[a]	All (n=361)	Diabetes (n=120)	No diabetes (n=241)	p-value[b]
Age (years)	64.94 ± 13.69	63.64 ± 11.8	65.58 ± 14.51	0.175
Sex				
Female	182 (50.4)	66 (55)	116 (48.1)	0.219
Male	179 (49.6)	54 (45)	125 (51.9)	
Blood pressure (mmHg)				
SBP	120.1 ± 26.69	122.60 ± 27.19	118.90 ± 26.40	0.215
DBP	71.94 ± 12.53	72.19 ± 11.67	71.81 ± 12.95	0.787
Smoker				
Yes	184 (51)	71 (59.2)	113 (46.9)	0.028*
No	177 (49)	49 (40.8)	128 (53.1)	
Length of stay (days)	15.58 ± 13.82	16.17 ± 13.94	15.28 ± 13.78	0.567
Status of discharge				
Dead	46 (12.7)	10 (8.3)	36 (14.9)	0.051
Alive	315 (87.3)	110 (91.7)	205 (85.1)	
Home medications				
CCB	36 (10.0)	12 (10.0)	24 (10.0)	0.990
Beta-blocker	125 (34.6)	55 (45.8)	70 (29.0)	0.002*
ACE inhibitor	80 (22.2)	32 (26.7)	48 (19.9)	0.146
ARB	32 (8.9)	10 (8.3)	22 (9.1)	0.802
Diuretic	87 (24.1)	33 (27.5)	54 (22.4)	0.286
Statin	82 (22.7)	34 (28.3)	48 (19.9)	0.072
PPI	87 (24.1)	35 (29.2)	52 (21.6)	0.112
ATB	97 (26.9)	32 (26.7)	65 (27)	0.951
Serum creatinine (mg/dL)	2.469 ± 10.41	3.43 ± 18.6	2.00 ± 3.15	0.246
Liver function test (IU/L)				
SGPT/ASAT	34.67 ± 51.16	25.27 ± 18.09	39.50 ± 61.10	0.002*
SGOT/ALAT	28.06 ± 39.59	24.24 ± 29.19	29.97 ± 43.81	0.218
Lipid panel (mg/dL)				
Cholesterol	161.61 ± 66.7	161.92 ± 88	161.40 ± 47.63	0.956
Triglyceride	145.8 ± 80.5	160.04 ± 90.24	135.99 ± 71.81	0.043*
LDL	103.27 ± 37.3 35.38 ±	99.71 ± 34.51	105.71 ± 39.12	0.261
HDL	16.26	34.89 ± 14.81	35.71 ± 15.93	0.724

[a] Data are expressed as mean ± standard deviation or as frequency (percentage); [b] By Student-t-test for continuous variables and Chi-square for binary variables; * Statistically significant results; ACE, angiotensin II; ARB, angiotensin II receptor blocker; ATB, antibiotics; CCB, calcium channel blocker; DBP, diastolic blood pressure; HDL, high density lipoprotein; LDL, low density lipoprotein; PPI, proton pump inhibitor; SBP, systolic blood pressure; SGOT/ALAT, alanine aminotransferase; SGPT/ASAT, aspartate aminotransferase.

Table 2: Distribution of comorbidities among cases and controls.

Presence of comorbidities	Diabetes[a]		p-value[b]
	Yes	**No**	
Hypertension	94 (78.3)	171 (71)	0.135
Neuropathy	60 (50)	21 (8.7)	<0.001*
Nephropathy	21 (17.5)	2 (0.8)	<0.001[c,*]
Retinopathy	31 (25.8)	1 (0.4)	<0.001[c,*]
Congestive heart failure	31 (25.8)	53 (22)	0.416
Myocardial infarction	36 (30)	72 (29.9)	0.981
Arrhythmia	14 (11.7)	34 (14.1)	0.520
Dyslipidemia	79 (65.8)	104 (43.2)	<0.001*
Asthma	8 (6.7)	14 (5.8)	0.748
COPD	13 (10.8)	50 (20.7)	0.019*
Chronic renal failure	28 (23.3)	59 (24.6)	0.810
Gastrointestinal tract disease	40 (33.3)	62 (25.7)	0.130
Cirrhosis	12 (10)	19 (7.9)	0.499

Metastatic cancer	5 (4.2)	7 (2.9)	0.529[c]
Non-metastatic cancer	27 (22.5)	38 (15.8)	0.117
Infection	53 (44.2%)	98 (40.7%)	0.525
Cerebrovascular accident	25 (20.8%)	45 (18.6%)	0.625
Depression	8 (6.7%)	16 (6.6%)	0.992

[a] Data are expressed in frequency (n) and percentage (%); [b] p-value detected by Pearson Chi-square test; [c] p-value detected by Fisher's exact test; * Statistically significant results; COPD, chronic obstructive pulmonary disease.

II Bivariate analysis

Distribution of comorbidities among cases and controls

Predictably, and as shown in Table 2, the patients with diabetes had higher prevalence of neuropathy (50.0% *vs* 8.7% respectively, p-value <0.001), nephropathy (17.5% *vs* 0.8% respectively, p-value <0.001), retinopathy (25.8% *vs* 0.4% respectively, p-value <0.001), and dyslipidemia (65.8% *vs* 43.2% respectively, p-value <0.001). While, non-diabetic patients had a higher prevalence of chronic obstructive pulmonary disease (COPD, 20.7% *vs* 10.8% respectively, p-value: 0.019).

Table 3: Comparison between cases and controls concerning number of comorbidities and scores.

Comorbidity[a]	Cases	Controls	p-value[b]	95% CI
Comorbidity number	6.25 ± 2.33	4.04 ± 1.81	<0.001*	1.731; 2.687
Comorbidity numbers – noDM	5.28 ± 2.34	4.04 ± 1.81	<0.001*	0.757; 1.72
CCI	6.29 ± 2.94	4.72 ± 2.47	<0.001*	0.995; 2.15
CCI-noDM	4.66 ± 2.89	4.72 ± 2.47	0.84	-0.635; 0.520
CIRS	16.22 ± 5.84	11.50 ± 4.85	<0.001*	3.470; 5.910
CIRS-noDM	13.58 ± 5.74	11.50 ± 4.84	0.001*	0.875; 3.281

[a] Data are expressed as mean ± standard deviation; [b] p-value obtained by student-t-test; *Statistically significant results; comorbidity number - noDM, comorbidity numbers excluding diabetes mellitus; CCI, Charlson Comorbidity Index; CCI-noDM, modified CCI score excluding diabetes mellitus; CI, confidence interval; CIRS, Cumulative Illness Rating Scale; CIRS-noDM, modified CIRS score excluding diabetes mellitus.

Table 3 shows the comparison of comorbidities between diabetic and non-diabetic patients. Concerning the number of comorbidities, the diabetic patients scored a higher number of comorbidities relative to that of non-diabetics (6.25 *vs* 4.04 respectively, p-value <0.001, 95% CI: [1.73; 2.69]). Higher comorbidities were also shown by scores used in this study: CIRS (16.22 *vs* 11.50 respectively, p-value <0.001, 95% CI: [3.47; 4.74]) and CCI (6.29 *vs* 4.72 respectively, p-value <0.001, 95% CI: [0.99; 2.15]). However, after the exclusion of "diabetes" item from both scores, differences were no longer significant for CCI-noDM while it remained significant for CIRS-noDM

Predictors that may be affecting the length of stay and mortality

The mean LOS in the whole population under study was 15.58 ± 13.82 days. It did not significantly differ between cases and controls (p-value: 0.567). A significant positive correlation was detected between LOS and CIRS-noDM (r: 0.216, p-value <0.001), and between CCI-noDM and LOS (0.183, p-value: 0.001). Of the 361 patients, 46 (12.7%) died during hospitalization period. Survival according to diabetic status was analyzed using Kaplan-Meier curves. The mortality rates were 8.3% and 14.9% in diabetic and non-diabetic patients, respectively (p-value: 0.036 by log-rank test). Mortality rate was higher in non-diabetic patients, patients with hypertension, infection, myocardial infarction, depression, arrhythmia, anemia, acquired immunodeficiency syndrome, hematological malignancy, fluid and electrolyte disorder, and metastatic cancer. Older patients and those having comorbidity ≥3 had higher mortality rate. Dead patients had higher CCI-noDM and CIRS-noDM score (data not shown).

Table 4: Predictors that affect the length of stay.

Predictors[a]	Unstandardized β	Standardized β	p-value	95% CI
DM	-0.277	-0.009	0.854	-3.241; 2.690
CIRS-noDM	0.451	0.171	0.001*	0.183; 0.721
CCI-noDM	0.723	0.137	0.008*	0.189; 1.260
Infection	-6.612	-0.236	<0.001*	-9.380; -3.841

[a] Data obtained by linear regression; *Statistically significant results; CCI, Charlson Comorbidity Index; CCI-noDM, modified CCI score excluding diabetes mellitus; CI, confidence interval; CIRS, Cumulative Illness Rating Scale; CIRS-noDM, modified CIRS score excluding diabetes mellitus; DM, diabetes mellitus.

III Multivariate analysis

Predictors of the length of stay

Two linear regressions were done, where CCI-noDM and CIRS-noDM were used in two different models. Global test of the model ANOVA was significant (p-value <0.001). Preliminary analyses were conducted to ensure no violation of the assumptions of normality, linearity, multicollinearity and homoscedasticity of the dependent variable. In the final models, only three variables were retained as statistically

significant: CIRS-noDM (beta: 0.171, p-value: 0.001; 95% CI: [0.18; 0.72]), CCI-noDM (beta: 0.723, p-value: 0.008; 95% CI: [0.189; 1.26]), and infection (beta: -6.612, p-value <0.001; 95% CI: [-9.38; -3.84]). When we force diabetes variable in another model it shows that it is not a statistically significant predictor of the dependent variable (beta: -0.009, p-value: 0.854; 95% CI: [-3.24; 2.69]) (Table 4).

Predictors of mortality

Independent variables included in Cox-model after checking their proportional hazards hypothesis adequacy were: CIRS-noDM, CCI-noDM and DM (Yes/No) variable. All variables were retained: DM variable (HR: 2.638, p-value: 0.009; 95% CI: [1.28; 5.43]), CIRS-noDM (HR: 1.086, p-value: 0.001; 95% CI: [1.032; 1.142]), and CCI-noDM (HR: 1.156, p-value: 0.002; 95% CI: [1.057; 1.265]) as statistically significant predictors of mortality (Table 5).

Table 5: Main predictors that increase mortality rate in the studied population detected by Cox hazard proportional model.

Predictors	β	p-value	HR	95% CI
DM	0.97	0.009*	2.638	1.281; 5.432
CIRS-noDM	0.082	0.001*	1.086	1.032; 1.142
CCI-noDM	0.145	0.002*	1.156	1.057; 1.265

*Statistically significant results; β, regression coefficient; CCI, Charlson Comorbidity Index; CCI-noDM, modified CCI score excluding diabetes mellitus; CI, confidence interval; CIRS, Cumulative Illness Rating Scale; CIRS-noDM, modified CIRS score excluding diabetes mellitus; DM, diabetes mellitus; HR, hazard ratio.

Association between comorbidity and diabetes

In order to check for the association between comorbidities and diabetes, we conducted a forward logistic regression, with diabetes as the dependent variable and all comorbidity with p-value ≤0.2 as the independent variables Table 2. Three variables show a significant association with the dependent variable and they are as follow: neuropathy (OR: 8.1, p-value <0.001; 95% CI: [4.32; 15.16]), nephropathy (OR: 7.75, p-value: 0.014; 95% CI: [1.5; 39.9]), and retinopathy (OR: 67.78, p-value <0.001; 95% CI: [8.78; 52.28]).

Discussion

This retrospective study aimed at evaluating comorbidity in diabetic patients and studying the impact of diabetes on the LOS and mortality in a sample of 361 patients. We mainly found that comorbidities rather than diabetes by itself affected LOS, while both diabetes and comorbidity increased mortality rate of hospitalized patients. Regarding LOS, our study showed that diabetic patients spend one day longer than non-diabetic patients, but the difference was not significant, which support the results of a previous study (cases LOS: 48 days *vs* 46.3 days for controls, p-value: 0.775) [19].

Our results demonstrate that non-diabetic patients were three times more prone to die compared with diabetic patients. This result was in accordance with the study of Zekry et al. that showed a weak association between diabetes and mortality risk (HR: 1.36, p-value: 0.079; 95% CI: [0.97; 1.91]) [20]. This may be due to the fact that diabetes associated mortality have been diluted by the inclusion of patients with recent onset of diabetes. Also, maybe one of the main reasons was the high prevalence of COPD in non-diabetic patients (20.7% in controls *vs* 10.8% in cases, p-value: 0.019). The COPD represents an increasing burden worldwide, reported to be the sixth leading cause of death in 1990, and the fourth in 2000 [21-22]. Discouragingly, it is projected to jump to third place by the year 2020 [22].

But, those results contradict previous studies on younger adults, Rao Kondapally Seshasai et al. have reached a result that link diabetes to

mortality where HR among persons with diabetes as compared with persons without diabetes were as follows: 1.80 (95% CI: [1.71;1.90]) for death from any cause, 1.25 (95% CI: [1.19;1.31]) for death from cancer, 2.32 (95% CI: [2.11;2.56]) for death from vascular causes, and 1.73 (95% CI: [1.62;1.85]) for death from other causes [19, 23]. A multivariable analysis showed that DM was associated with a modestly lower risk-adjusted survival to hospital discharge (adjusted OR [aOR]: 0.96; 95% CI: [0.95; 0.97], p-value <0.001) [24]. Diabetes has been shown to be implicated to mortality in many studies. Another study done previously also proved that diabetes was significantly associated with increased all-cause mortality (RR [95% CI] = 2.1 [1.3; 3.5] in men with p-value <0.001; 3.2 [1.9; 5.4] in women with p-value <0.001) and increased cardiovascular diseases mortality (3.2 [1.4; 7.1] in men with p-value <0.001; 8.5 [2.8; 25.2] in women with p-value <0.001) [25]. Many studies have demonstrated that diabetes is associated with an increase in both cardiovascular and all-cause mortality [25, 26]. A more recent study contradict our finding and showed that the mortality risk among individual with diabetes compared to those without diabetes was increased with a HR of 1.62 (95% CI: [1.51; 1.75]), and the same was shown by a study done by Karayiannides et al. [27, 28].

Both CIRS and CCI scores are validated for being used in the diabetic patients. Diabetic patients have a higher prevalence of comorbidity as proved by the total CIRS and total CCI score. Zekry et al. indicated that diabetes is linked to elevated comorbidity, as assessed by CIRS score (14.1 ± 4.8 in non-diabetic *vs* 17.3 ± 4.6 in diabetic; p <0.001); this was in agreement with our results (CIRS in non-diabetic: 11.50 ± 4.85 *vs* CIRS in diabetic: 16.22 ± 5.84, p-value <0.001) [20]. On the other hand, when diabetes item has been removed from the two scores: CCI score lost its significance (p-value: 0.84), while CIRS score remained statistically significant (CIRS-noDM in non-diabetic: 11.50 ± 4.84 *vs* CIRS-noDM in diabetic: 13.58 ± 5.74; p-value: 0.001) which is in accordance with the result of previous study (CIRS-noDM in non-diabetic: 13.8 ± 4.8 *vs* CIRS-no DM in diabetic: 15.1 ± 4.5, p-value: 0.016) [20].

Concerning CCI score, a study done showed that CCI was different between asthmatic and diabetic patients (1.77 ± 1.23 *vs* 1.42 ± 0.94

respectively) but no p-value was available to check if the difference provided was significant or not [22]. It emphasizes our results in this aspect, where CCI score was significantly different between both cases and controls. But there were no available studies that use a modified CCI in diabetic patients. The major strength of this study was that the filling of the scores and the questionnaire for each individual was managed by only one person, which decreases the inter variability and it ensures the same quotation and calculation of scores in all patients by the same way. The usage of two scores in this study is beneficial and of high quality, and the quotations of the level of the scores were validated by the investigator to ensure quality. In Lebanon, there is no published data that studies the effect of comorbidities on diabetic patients; it is the first study of kind.

Nevertheless, our study also had limitations. First, this analysis was conducted using medical records from the hospital database; it does not contain information on the duration of DM of all patients, so we could not control for disease severity. Diabetes duration and severity may be an important determinant of comorbidities. Second, the choice of the hospital may be the reason. Surprisingly, the turnover of patients during six months was low it may be due to private hospital problems. Third, a coding or miscoding of certain type of comorbidity may affect the prevalence of comorbidity; however it is unclear what the overall impact is. Fourth, selection of the control with chronic disease may be the cause behind obscuring the significant difference between the two groups studied. So, that cases and controls seem to be of same weight when comparing them using the modified scores. Fifth, survival bias is possible in very old patients, whereby patients with long standing diabetes die before reaching the age of elderly. So, it would be of great interest to stratify the mortality risk associated with diabetes according to diabetes duration in a larger study.

Future research should also include the evaluation of long term mortality, e.g. follow up of patients over a certain period of time after the discharge of the patient from the hospital, in order to fully understand the effect of comorbidities on both long term mortality and the quality of life in diabetic patients. Moreover, we suggest a large scale study which takes into account the duration of diabetes, and to study the impact of diabetes on the therapeutic progression.

Conclusion

In conclusion, this study provides insight to the association between comorbidities and diabetes where comorbidities in diabetic patients are more prevalent than non-diabetic patients, and it has been shown that as the number of comorbidities increases the risk of mortality increases among Lebanese patients. These results underline the importance of managing appropriately diabetes related comorbidities. This should be an important and integrated component of chronic disease management.

What is new?

Key findings

- This article provides an insight to the association between comorbidities and diabetes where comorbidities in diabetic patients are more prevalent than non-diabetic patients.
- It has been shown that as the number of comorbidity increases, the

risk of mortality and length of stay increase among Lebanese patients, a currently understudy population.

What this adds to what was known?

- In Lebanon, no study has systemically analyzed diabetes comorbidity so far. The resources concerning the assessment of comorbidities in diabetic patients are scarce, practices are not homogenous, and there are very few data that permit surveillance of diabetes, evaluate the competitive comorbidity factors and study the impact of diabetes on mortality.

What is the implication and what should change now?

- This study may help us to better understand the recently published death rate data and to develop future innovative and effective preventive strategies.
- The results underline the importance of managing comorbidities, where appropriately management should be an important and integrated component of chronic disease management.

Conflicts of interest

The authors have declared that no competing interests exist.

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