The Status of Metabolic Control in Patients With Diabetes Attending Primary Care Clinics in Madinah, Saudi Arabia

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Research

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Abstract

OBJECTIVE: Comprehensive control of diabetes and its related comorbidities is essential to avoid diabetes complications and reduce diabetes care expenses. Nevertheless, several reports have uncovered the gap in diabetes management and confirmed the suboptimal glycemic control globally. This study aims to assess the metabolic control among patients with diabetes attending primary care clinics (PCCs) in Madinah, Saudi Arabia.

METHODS: A cross-sectional study was conducted at 15 PCCS in Madinah, Saudi Arabia. Consecutive 692 adult diabetic patients who attended the clinics between January 2016 to December 2017 were included. The primary outcome measures were achieving blood glucose, blood pressure, and lipids goals. The achievement of adequate metabolic control followed the American diabetes association (ADA) guidelines.

RESULT: Majority (98%) of the patients had type 2 diabetes (T2DM) with a mean age of 55.1±11.6 years and a mean diabetes duration of 11.02±7.8 years. The mean HbA1c was 8.39±1.7, and glycemic goals (HbA1C < 7%) were achieved in 15.7%. Achievement of LDL, triglyceride, and HDL goals were as follow; 46.4%. 53.3%, 70.8%, respectively. 66.3% of subjects achieved systolic blood pressure, and 88.7% achieved diastolic blood pressure goals. Younger age, longer diabetes duration, and higher LDL levels were associated with poor glycemic control.

CONCLUSION: Glycemic control is inadequate among patients with diabetes following at the PCCs in Madinah, Saudi Arabia. A patient-centered approach and individualized management plan considering all risk factors are required.

Introduction

Diabetes mellitus and its micro-and macrovascular complications is a significant public health burden worldwide. Therefore, comprehensive control of diabetes and its related comorbidities, such as hypertension and dyslipidemia, is essential to avoid diabetes complications and reduce diabetes care expenses. Nevertheless, several reports have uncovered the gap in diabetes management and confirmed the suboptimal glycemic control globally.[1–7] The diabetes burden in Saudi Arabia is enormous, as its prevalence is increasing exceptionally. The International Diabetes Federation has graded Saudi Arabia as one of the top five countries with diabetes in the Middle East and North Africa region.[8]

In the past decade, the management of diabetes and its related comorbidities has improved significantly with many new therapies, technology, and robust international guidelines. Therefore, the status of metabolic control in patients with diabetes is expected to be better. While there are many published data on glycemic control and the reasons for poor glycemia from different regions of Saudi Arabia, there are few published data from the Madinah region.[9–13] In this study, we aimed to assess the control of blood glucose, blood pressure, and lipids among patients with diabetes attending PCCs in Madinah, Saudi Arabia.

Patients And Methods

A cross-sectional study was conducted among 15 PCCs across Madinah city, Saudi Arabia. Consecutive attendees of the clinics between January 2016 to December 2017 were included. Inclusion criteria were adult patients with diabetes (18 years and above) attending PCCs at Medina Region with a follow-up for at least one year. Patients with malignancies, chronic renal failure, and those on steroids, and pregnant women were excluded from the study. Ethical approval was obtained from the Institutional Review Board, General Directorate of Health Affair Medina, Saudi Arabia. All subjects signed written informed consent.

Participants were interviewed, and the following information was collected; age, sex, duration of diabetes, smoking status, comorbidities such as hypertension, hyperlipidemia, and ischemic heart disease, and diabetes microvascular complications (neuropathy, nephropathy, and retinopathy). The last laboratory results for HbA1C, creatinine, and fasting lipid profile (total cholesterol, high-density lipoprotein (HDL), low-density lipoprotein (LDL), and triglycerides) were recorded.

Anthropometrics (weight and height) and blood pressure were measured for all subjects. Body mass index (BMI) was calculated as weight/height (m^2).

The achievement of adequate metabolic control in this study followed the ADA guidelines: HbA1C <7%, LDL <2.6 mmol/L, HDL >1 mmol/L, triglyceride <1.7 mmol/L, systolic blood pressure (SBP) <140 mmHg, and diastolic blood pressure (DBP) <90 mmHg.[14]

SPSS software (v 20.0, SPSS Inc, Chicago, IL, USA) was used to perform the statistical analyses. For continuous data, the mean and standard deviation were computed, and for categorical variables, percentages were employed. The significance of differences between two continuous variables was determined using the student's t-test. The chi-squared test was used to assess for differences in the categorical variables. $P < 0.05$ was the cut-off value indicating significance.

Results

A total of 692 subjects with diabetes were included: 676 patients (98%) with T2DM and 14 (2.0%) with T1DM. The mean age was 55.1±11.6 years, the mean BMI was 32.1±7.0 kg/m2, and the mean duration of diabetes was 11.02±7.8 years. Table 1 shows the baseline characteristics of the participants and the differences in glycemic control and cardiovascular comorbidities between males and females. We did not find significant differences in the glycemic control between both genders. Females had higher BMI and more history of dyslipidemia. However, they did have other favorable cardiovascular comorbidities and fewer diabetes complications than males. For example, they had lower triglyceride levels and higher HDL levels and were less affected by hypertension, coronary artery disease, and smoking than males. In addition, they had fewer diabetes microvascular complications such as diabetic retinopathy, nephropathy, and neuropathy.

The mean HbA1c was 8.39±1.7; however, glycemic goals (HbA1C < 7%) were attained in 15.7% of the subjects. Table 2 shows the achievement of glycemic, lipid, and blood pressure goals among the subjects. The degree of control of diabetes and other cardiovascular risks among the participants is presented in Table 3.

Younger age and longer diabetes duration were found to be associated with poor glycemic control. Subjects who achieved glycemic goals had significantly lower LDL levels and achieved more LDL goals than those who did not achieve glycemic control. Table 4 shows the differences between patients with reasonable glycemic control vs. poorly controlled.

Discussion

In a country like Saudi Arabia, where diabetes is highly prevalent, proper control is paramount. In the present study, the proportion of adult patients with diabetes attending PCCs in Madinah, Saudi Arabia achieving glycemic goals was deficient (15.7%); i.e., approximately only one in seven patients reached the target. Despite newer therapies and greater availability of diabetes technology, glycemic control remains suboptimal worldwide.[1–13] In a previous nationwide cross-sectional study conducted among 28 PCCs all over Saudi Arabia during December 2006, 27% of diabetic patients had reached the target HbA1c of <7%.[15] At the diabetes care clinics of the National Guard Health Affairs, Riyadh, diabetes control reached 20.6%.[9] In King Khalid University Hospital's PCC, Riyadh, reasonable glycemic control was achieved in 32.3% of patients.[10] A similar result was reported from PCCs from the Al-Hasa district of Saudi Arabia.[11] Good glycemic control among type 2 diabetes patients was reported to be 23.6% from Diabetes Centre in Madinah.[12] In general, the reported achievement of glycemic target in patients with diabetes from different regions ranges of Saudi Arabia ranged from 24-40%.[13]

Similar results to ours were reported from Pakistan [2] and Sudan [3], in which only 16.6% and 15.0% of the participants, respectively, reached the glycemic target. In a specialized diabetes clinic and research center from Kuwait, the proportion of patients with reasonable glycemic control (HbA1c level < 7%) was 29.5%.[4] Glycemic control among Jordanian patients with type 2 diabetes was reported to be 35%.[16] A study from Japan reported glycemic control in 44.9% of diabetic patients. [1] In a meta-analysis that included 24 studies from 20 countries, the pooled glycemic target achievement rate was 42.8%, highest in North America and Europe than the rest of the world.[5] Contrary to this finding, a recent study from the United States of America (USA) revealed that glycemic control has not improved among type 1 diabetes patients between 2016–2018 compared to the period between 2010–2012 and even has worsened in adolescents. Only 17% of the youths met the HbA1c target of <7.5%, and 21% of the adults met the target of <7.0%.[6] Likewise, another study from the USA unveiled the improvement that noticed in glycemic control between 1998 and 2010 has plateaued during 2007-2014.[7]

We found younger age to be linked with poor glycemic control. In comparison, previous studies observed age younger than 45 years to be associated with a higher risk of inadequate glycemic control.[17,18] This

finding could be attributed to less adherence to the management plan due to irregularity of their lifetime with active jobs and busy social events.[19] Therefore, focusing on this group of patients may be necessary as they would benefit utmost from treatment. Longer duration of diabetes was associated with poor glycemic control, a finding concurrent with many previous studies.[16,20] Higher LDL levels were observed in this study to have a significant association with non-glycemic control; a finding that is consistent with many other studies.[16,20]

Other factors for poor glycemic control that were out of the present study's scope are unhealthy nutritional habits, low physical activity, low medication adherence, irregular follow-up, and psychological stresses. The cost of drugs can be a barrier against optimal glycemic control; however, in Saudi Arabia, visits to the PCCs and medications are provided freely to Saudi patients.

Poor self-monitoring of blood glucose could also account for inadequate glycemic control. Insufficient blood glucose monitoring is a common practice among diabetic patients, which could be related to a needle phobia, busy life, and the expense of blood glucose strips.

Previous findings have shown that patients with more knowledge of diabetes have better glycemic control than those with less knowledge. 21,22 Many studies have demonstrated that knowing the HbA1c level and understanding the individual glycemic target to be associated with better glycemic control.21,22 Awkwardly, less than a third of participants in one study from Saudi Arabia were aware of their HbA1c level and knew the recommended target. The remaining study participants had never heard of HbA1c (32.0 %) or had no awareness of their HbA1c goal (36.1 %).[13] Physicians and diabetes educators should convey to the diabetic patients their HbA1c level at each clinic visit and the target they should achieve to improve glycemic control.

Primary care physicians' knowledge and the application of updated guidelines for the management of diabetes may not be optimal and may add to the hurdle to achieving glycemic control. Clinical inertia is a crucial barrier to achieving euglycemia. Therapy must be intensified whenever glycemic control deteriorates, and referral to a diabetes specialist or an endocrinologist should be performed when glycemic control is deemed complicated. Therapeutic inertia not only affects diabetes management but also affects other cardiovascular diseases such as hypertension and dyslipidemia. Strategic plans to prevail over clinical inertia must include actions that target patients, physicians, and health care systems. Multifactorial interventions that act on different therapeutic goals beyond glycemia are needed.[23]

In the present study, the control of LDL cholesterol was better than glycemic control, as nearly half of the patients achieved the goal. This result is comparable to the metanalysis mentioned above[5] and better than the study from Japan [1], in which only 27.1% achieved the target. Achievement of triglyceride goal was slightly better than LDL (53.3% vs. 46.4% respectively), comparable to the results from a study from Saudi Arabia [10], but less than the results from the metanalysis in which the pooled target achievement was 61.9% (55.2-68.2%).[5] HDL-C was the best lipids parameter controlled in the current study as 70.8%

achieved the target. This result is better than the metanalysis results, in which 58.2% (51.7-64.4%) reached the goal for HDL-C.[5]

Blood pressure was the best risk of atherosclerotic cardiovascular diseases controlled in our participants, as the systolic blood pressure was controlled in about two-thirds of the participants, and the diastolic blood pressure was controlled in almost 90 %. This result is comparable to studies from Japan [1] and USA [5], while better than other parts of Saudi Arabia. In the meta-analysis mentioned above, only 29.0% (22.9-35.9%) achieved blood pressure targets, with a greater percentage of people accomplished the targets in North America than in the rest of the world.[5]

Smoking is an essential risk for cardiovascular diseases, particularly in patients with diabetes. One-quarter of the males in this study were smokers, while smoking was infrequent in females. Quitting smoking is vital for patients with diabetes, and smoking cessation approaches should be implemented.

Despite the inadequate glycemia in our cohort of patients, other cardiovascular diseases risk such as dyslipidemia and hypertension were better controlled. These results are similar to the results of Steno-2 trial, in which the treatment goals for dyslipidemia and hypertension were accomplished without much hassle. However, the most challenging target was achieving the HbA1c goal, as only 15% of the patients in the intensive group reached the glycemic target.[23] Controlling dyslipidemia and hypertension in patients with type 2 diabetes has shown to cause more significant reductions in cardiovascular events than controlling hyperglycemia.[24,25] Multidisciplinary intervention that targeted hyperglycemia, hypertension, dyslipidemia, and smoking in patients with diabetes is the key to reduce the risk of micro and macrovascular complications, as demonstrated in the Steno-2 trial and the follow-up study.[23,24]

There are some limitations to this study; cross-sectional studies lack temporality, so cause and effect cannot be assumed. In addition, we did not investigate the factors that influence glycemic control, such as lifestyle: nutritional habits and physical activity, medication adherence, education level, and psychological status. While our results apply to a specific area in Saudi Arabia, the results cannot be fully generalized to other regions. Nonetheless, the present study uncovered the burden of inadequate glycemic control among patients with diabetes in Saudi Arabia. Therefore, this study emphasizes the need for operative strategies that effectively manage diabetes at the PCCs in Saudi Arabia.

In conclusion, glycemic control is inadequate among patients with diabetes following the PCCs in Madinah, Saudi Arabia. Effective and continuous education that raises patients' knowledge about diabetes and promotes behavioral changes and a healthy lifestyle is crucial in diabetes management. A patient-centered approach and individualized management plan considering all risk factors are required. A stepwise, target-driven approach to achieve the goals for blood glucose, blood pressure, and levels of LDL and triglycerides should be applied. A multidisciplinary team, including a physician, diabetes educator, and clinical dietitian, should share managing patients with diabetes. Continuous medical education on diabetes management for primary health care physicians is recommended to ensure

updated guidelines application. Further research is needed to find other approaches that improve glycemic control in Saudi Arabia.

Declarations

Ethics approval and consent to participate

Ethical approval was obtained from the Institutional Review Board, General Directorate of Health Affair Medina, Saudi Arabia. IRB-165

Consent for publication

All subjects signed written informed consent.

Availability of data and materials

Competing The datasets used and/or analysed during the current study are available from the corresponding author on reasonable request.

Interests

The authors declare that they have no competing interests"

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Authors' contributions

EMA conceptualized the idea of research based on importance and relevance of the topic and contributed in literature search, provided research materials,. AMS identified the appropriate methods of analysis, interpreted the results of study and wrote final draft of article. GMS helped in enriching references and writing discussion of the study. All other authors have contributed in collected and organized data and references and provided logistic support critically review All authors read and approved the final manuscript.

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Not applicable

CONFLICT OF INTEREST

None.

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Tables

Table 1: Bassline characteristics of the participants and differences in glycemic control and cardiovascular comorbidities between males and females.

	Total (n=692)	Males (n=183) (26.4%)	Females (n=509) (73.6%)	P value
Mean ±SD				
Age (years)	55.1±11.6	56.3±12.9	54.7±11.1	0.27
Weight (Kg)	79.4±17.6	80.9±17.5	78.91±17.7	0.207
BMI (Kg/m^2)	32.1±7.0	29.4±6.0	33.1±7.1	0.000
Duration of diabetes (years)	11.02±7.8	12.66±7.9	10.42±7.8	0.002
HbA1c %	8.39±1.7	8.47±1.8	8.36±1.9	0.505
Fasting glucose	9.7±4.2	10.0±4.7	9.6±4.0	0.314
LDL (mmol/L)	2.8±1.04	2.75±1.04	2.87±1.04	0.319
HDL (mmol/L)	1.14±0.38	1.07±0.38	1.17±0.37	0.018
Triglyceride (mmol/L)	1.69±0.92	1.84±1.2	1.64±0.80	0.017
SBP (mm Hg)	132.3±20.27	131.1±21.6	132.7±19.8	0.372
DBP (mm Hg)	74.3±11.6	78.05±11.7	73.05±12.0	0.000
Percentages (%)				
Diabetic retinopathy	17.9	19.1	17.5	0.59
Diabetic nephropathy	8.5	8.7	8.4	0.000
Diabetic neuropathy	23.3	25.1	22.6	0.000
Hypertension	61.2	83.9	55.1	0.000
Dyslipidemia	44.5	41.0	45.8	0.000
Coronary artery disease	10.4	13.1	9.4	0.004
Smoking	6.8	24.0	0.6	0.000

Table 2: Achievement of glycemic, lipid, and blood pressure control in 692 subjects with diabetes. SBP: Systolic blood pressure; DBP: Diastolic blood pressure.

Parameters	Percentages (%)
HbA1C < 7%	15.7
Low density lipoprotein (LDL) <2.6mmol/L	46.4
High density lipoprotein (HDL) >1mmol/L	70.8
Triglyceride <1.7mmol/L	53.3
SBP <140mmHg	66.3
DBP <90mmHg	88.7

Table 3: The control of diabetes and cardiovascular risks among 692 subjects with diabetes.

Measures	
Mean (±SD) hemoglobin A1c (%)	8.4±1.9
Hemoglobin A1c%	**Percentages (%)**
<6.0	2.5
6.0%-6.9	13.2
7.0%-7.9	23.1
8.0%-8.9	27.9
9.0%-9.9	14.3
≥10.0	19.0
Mean (±SD) total cholesterol level (mmol/L)	4.8±1.07
Total cholesterol level (mmol/L)	**Percentages (%)**
<5.2	73.6
5.2-6.1	18.8
≥6.2	7.7
Mean (±SD) LDL cholesterol level (mmol/L)	2.8±1.00
LDL cholesterol level (mmol/L)	**Percentages (%)**
<2.6	46.4
2.6-3.3	29.9
3.4-4.1	15.6
≥4.2	8.1
Mean (±SD) HDL cholesterol level (mmol/L)	1.1±0.38
HDL cholesterol level (mmol/L)	**Percentages (%)**
<1.0	29.2
1.0-1.3	48.5
1.31-1.49	11.2
≥1.5 mmol/L	11.1
Mean triglyceride level (mmol/L)	1.7±0.92
Triglyceride level (mmol/L)	**Percentages (%)**
<1.7	53.3

1.7-2.2	31.5
2.3-4.4	14
≥4.5	1.2
Mean (±SD) systolic blood pressure (mm Hg)	132.3±20.2
Systolic blood pressure (mm Hg)	**Percentages (%)**
< 120	24.3
120 -129	21.1
130 -139	20.9
140 -149	15.6
150 -159	7.3
160 -169	5.6
170 -179	2.6
≥180	2.6
Mean (±SD) diastolic blood pressure (mm Hg)	74.3±12.1
Diastolic blood pressure (mm Hg)	**Percentages (%)**
<80 mm Hg	61.3
80-89	27.4
90-99	8.9
100-109	1.5
≥ 110	0.9

Table 4: Differences between patients with reasonable glycemic control vs. poorly controlled. SBP: Systolic blood pressure; DBP: Diastolic blood pressur

Variable	Patients with A1c <7	Patients with A1c ≥7	P value
Mean± SD			
Age (years)	57.2±12.4	54.6±11.7	.037
Duration of diabetes (years)	8.3±7.4	11.3±7.7	.000
Weight	80.5±18.2	79.2±17.5	.501
BMI	32.4±6.8	32.0±7.0	.599
Height	157.5±9.4	157.5±9.0	.969
Systolic BP	131.1±20.8	132.2±20.1	.621
Diastolic BP	74.0±11.9	74.2±12.0	.843
Fasting glucose	8.0±3.7	10.0±4.2	.000
HbA1C	6.2±0.5	8.8±1.7	.000
Total cholesterol	4.7±1.1	4.8±1.1	.617
LDL	2.6±1.0	2.9±1.0	.045
Triglyceride	1.6±0.6	1.7±1.0	.176
HDL	1.1±0.3	1.1±0.4	.764
Serum creatinine	77.6±42	75.132	.521
Percentages (%)			
Sex: male/ female	18.1/ 16.3	81.9/83.7	.633
LDL <2.6mmol/L	28.7	18.5	.025
HDL >1mmol/L	66.7	69.9	.292
Triglyceride <1.7mmol/L	64.8	59.6	.181
SBP <140mmHg	71.3	68.4	.315
DBP <90mmHg	89.8	89.5	1.00