The Impact of Covid-19 on Diabetes Care in Muscat Governorate: A Retrospective Cohort Study in Primary Care

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Abstract

Background: COVID-19 pandemic has led to health service modification and temporary disruption of the routine care provided to patients with diabetes mellitus (DM) in primary care. This was done to minimize outpatient visits, permit physical distancing, and ensure patients' and healthcare providers safety. There is no evidence that explored or measured the impact of COVID-19 pandemic on diabetes services and patients' glycemic outcome in Oman. **Aim and Objectives:** To explore the accessibility of DM services in primary care after COVID-19 pandemic announcement, and measure patients' glycemic outcome. **Methods:** Before and after, retrospective cohort study using Al-Shifa healthcare database in primary care. One thousand adult patients with diabetes who attended DM clinic before pandemic announcement in 2019 were randomly selected and followed up until end of 2020. Patients aged ≥18 years and had at least 2 visits in 2019 were included. Access to DM services was identified by number of patients received care, frequency of consultations, mode of consultation, and type of intervention given to patients. Patients' glycated hemoglobin (HbA1c), and other glycemic parameters after pandemic announcement in 2020 were determined and compared with the same parameters before pandemic in 2019. Association between patients' HbA1c and mode of consultation was measured using multivariable regression analysis. **Results:** A total of 937 patients continued to follow and received DM care after pandemic announcement. Median number of consultations was 2 with interquartile range (IQR): 3-2. 57.4% had face-to-face alone, 32.4% had combined face to face and telephone consultation, and 10% had telephone consultation alone. Mean difference in HbA1c (%) before and after pandemic announcement was 0.2 ± 1.4 (95% CI: 0.1 to 0.3), *P*=.002. With multivariable linear regression, the mean difference in HbA1c was −0.3 (−2.3 to 1.5), *P*=.734 for telephone consultation alone, −0.5 (−2.4 to 1.4), *P*=.613 *for face-to-face alone*, and −0.5 (−2.4 to 1.3), *P*=.636 for combined consultations, compared to those who did not receive any formal consultation. **Conclusion:** Despite service modification and disruption of comprehensive care in primary care after COVID-19 pandemic announcement, DM services were accessible as majority of patients maintained follow up. There was an overall increase in mean glycated hemoglobin, however, it was a less than 1 unit increase. After adjusting for multivariable, glycated hemoglobin was reduced among those who received consultation including telephone consultation compared to those who did not, however evidence was unconvincing.

Keywords

COVID-19, diabetes, primary care, Oman

Background

Diabetes (DM) is one of the most common chronic diseases worldwide,[1] and is a well-known determinant for severe COVID-19, increasing the risk for devastating complications such as adult respiratory distress syndrome (ARDS) and multi-organ failure.[2] It has been reported that among

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patients who died from coronavirus infection, 30% had diabetes, and considered the second most common comorbidity after hypertension in patients with COVID-19.[3]

A retrospective study of 1122 adult patients with COVID-19 from 88 hospitals in the US reported a mortality rate of 28.8% in patients with diabetes and/or uncontrolled hyperglycemia, compared with 6.2% in patients without diabetes ($P < .001$). Among the discharged survivors, median length of stay was longer in patients with diabetes and/or uncontrolled hyperglycemia compared with patients without diabetes or hyperglycemia (5.7 vs 4.3 days, $P < .001$).[4]

By knowing that 20% to 40% of people within the pandemic had diabetes,[2] it becomes essential to put preventive measures into action to minimize the risk of death and disease complication.

In Oman, the crude prevalence of diabetes among middle aged adults was 16.1%.[5] 32% of patient admitted for COVID-19 were known to have diabetes, which was the most common comorbidity.[6]

COVID-19 continued to surge worldwide to reach around 60 000 000 cases and 1 400 000 deaths until November 2020.[7-9] In Oman, the situation was not different from that of the world. A total of 121 360 cases and 1365 deaths were reported up to November 22, 2020,[10] and number continues to incline.[11,12] The ministry of health (MOH) responded and gave instructions to seize routine health care services temporarily as an action to minimize outpatient visits and permit physical distancing. Besides that, healthcare workers were relocated and directed toward COVID-19 care to cover the demand of community screening, detection, and tracing. Eventually, the routine follow-up for patients with chronic disease was interrupted, especially during the peak, and telephone consultations were introduced to maintain communication with patients.[13,14]

A hospital-based study in Bahrain evaluated the effectiveness of using telemedicine, after ceasing diabetes clinics, on 1972 patients with diabetes over 4 weeks to provide necessary care. They found that many patients continued to follow up as walk-in visits and only 4% of their patients were unreached. However, the telephone communication method was time consuming and required more staff to maintain the service ongoing.[15]

There is lack of evidence about the consequences of COVID-19 pandemic on diabetes care in Oman. In fact, studies on this matter are scarce particularly at primary care level. The aim of this study was to explore the accessibility of DM services during COVID-19 pandemic and measure diabetic patients' glycemic outcome. Secondary objective was to determine the association between glycemic parameter and DM service during pandemic.

Methods

This is a before and after, retrospective cohort study of adults with diabetes who followed up in DM clinic in Muscat governorate primary care, before and after COVID-19 pandemic announcement. Data was extracted from diabetes clinic database through electronic health information system (Al-shifa) which is a national electronic database that contains clinical and relevant information for patients registered in health care facilities in Oman including primary care centers.[16]

We included patients aged ≥18 years, who have been following up in DM clinic in 2019, with at least 2 consultations. Patient who died or transferred out the health center before pandemic announcement was excluded. To ensure the generalizability of our data, patients with other co-existing comorbidities were not excluded from the study.

Outcomes of Interest

Primary Objective

Accessibility of DM services after pandemic announcement was quantified by determining the frequency of: of patients who sustained follow up, consultations per patient, mode of consultations, interventions given to patients, and month when DM care was received, in the year 2020. Frequency of patients and consultations were reported as discrete numerical. Other variables were categorical. Mode of consultation was categorized into telephone consultation alone, face-to-face alone, combined, or none (patient received regular medication but refused consultation). Interventions given to patients was categorized into health education, dietary counseling, modification of medication, and none (patients did not receive any of these interventions). Month when consultations was received was categorized into three four-month intervals: between January and April, May, and August, and from September to December.

The glycemic outcome was measured by calculating the differences in HbA1c and other glycemic parameters recorded before and after pandemic announcement in 2019 and 2020, respectively. The differences in latest test result for glycated hemoglobin (HbA1c), body mass index (BMI), blood pressure (BP), low density lipoprotein cholesterol (LDL-C), and estimated glomerular filtration rate (eGFR) was calculated. All parameters were measured in out-patient clinics by DM nurses using standard policy and procedure.

Secondary Objective

To determine the of association between glycemic parameter and DM services after pandemic announcement, we measured the association between HbA1c and mode of consultation for patients in the year 2020.

Exposure variable: Mode of consultation was used as a proxy for service modification.

Outcome of interest: HbA1c results recorded after pandemic announcement.
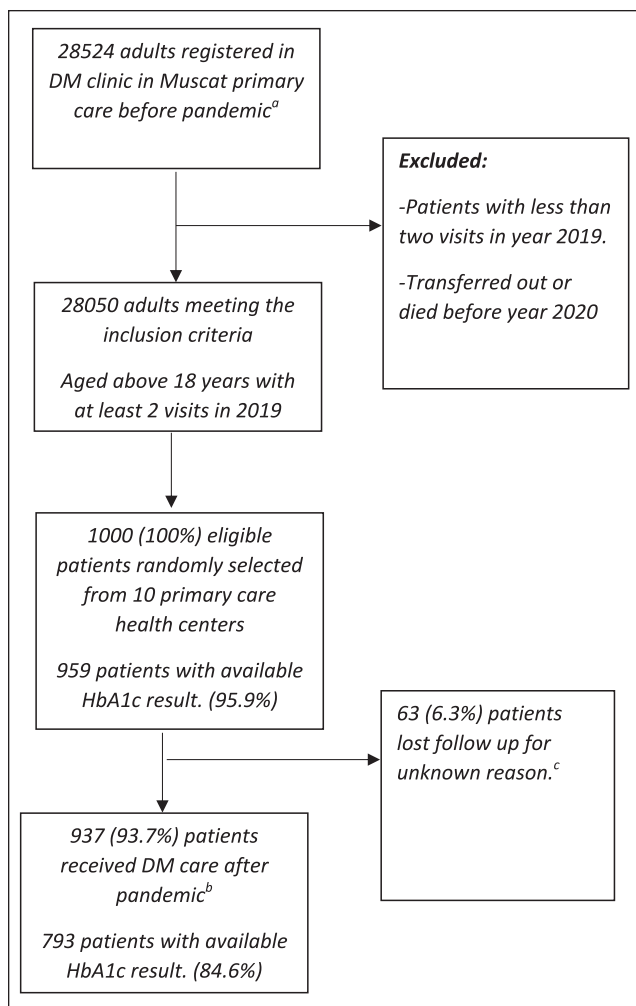
Figure 1. Flow of participants through study period before and after COVID-19 pandemic announcement, between 2019 and 2020.
[a]Before pandemic announcement in the year 2019.
[b]After pandemic announcement in the year 2020. DM, diabetes mellitus; HbA1c, glycated hemoglobin.
[c]Patients with loss of follow up are those who did not attend their scheduled appointment either by face-to face, neither by telephone. The reason for this is assumed to be due to fear from acquiring coronavirus infection as many of these patients were seen in clinic later on after the study period.

Confounders were age (discrete), sex (binary), whether patients had multi-morbid or one morbid disease, and pre-pandemic metabolic parameters, as binary variables.

Sample Size

1000 patients meeting the eligibility criteria were included. This was calculated from a pilot study that determined mean HbA1c before and after pandemic for a cohort of diabetic patients in primary care which as 7.5 and 7.7, respectively with a study power of 90% at 95% confidence interval which gave a sample size of 840. The sample was increased

to 1000 patients, to minimize the effect of margin error. The proportion of eligible DM patients in multicenter was determined from total DM patients in Muscat governorate. These proportions were used to calculate the sample size in each health center from the calculated study sample of 1000 (Supplemental Table 1).

Statistical Analysis

Continuous variables were described as mean (standard deviation [SD]) and median (interquartile range [IQR]), whereas categoric variables were presented as counts (frequency and percentages). Paired t-test was used to calculate and test the difference in glycemic parameters before and after pandemic announcement. Multivariable linear regression was used to measure the association between HbA1c and mode of consultation and to adjust for possible confounder variables. The distribution of the confounders (continuous variables) were tested for distribution whether symmetric or skewed to decide whether logarithmic transformation is required or not, before conducting multivariable regression analysis. Missing data was found in glycemic parameters. As we cannot be sure if these data are missing at random, rather than using imputation, we described how much data are missing. Sensitivity analysis was conducted to examine the following: (1) the difference in glycemic parameters after imputing the missing data with the mean value, (2) the association between HbA1c and mode of consultation for patients who followed up in Muscat health center, as all patients received face-to-face consultation alone. The reporting of this study followed Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) reporting guideline.[17] All analyses were performed using STATA version 17 and the statistical significance threshold was set at $\alpha = .05$.

Results

This study included 1000 patients with diabetes who attended DM clinic before pandemic announcement in 2019 and were followed up after pandemic announcement, in 2020. Figure 1 illustrates patients flow from the original source, after exclusions and random selection to form the eligible study cohort.

Table 1 shows the characteristics of study cohort. 57.3% of the study sample were females. The mean age at onset was 58.6 ± 12.3 years. Fifty percent of the cohort were ≥ 60 years old, 46.5% were between 36 and 59.9 (middle aged), and 3.9% were 18 to 35.6 years old (young adults). Median duration of diabetes was 10 years (IQR = 14-6).

Primary Objective

Accessibility of DM services during COVID-19 pandemic. Out of 1000 patients with diabetes before pandemic in 2019,

Table 1. Study Cohort Characteristics Before and After COVID-19 Pandemic Announcement.

Patients' characteristics	Before pandemic announcement in 2019	After pandemic announcement in 2020
No. of patients	1000	937
Age, years. Mean ± SD	58.6 ± 12.3	58.6 ± 12.3
Age groups in year. N (%)		
18-35.6 "young adults"	39 (3.9)	36 (3.8)
36-59.9 "middle aged"	465 (46.5)	441 (47.1)
≥60 year "elderly"	496 (49.6)	460 (49.1)
Sex. N (%)		
Female	573 (57.3)	544 (58.2)
Male	427 (42.7)	393 (42.1)
Mean duration of diabetes ± SD	10.3 ± 6.1	
No. of consultations. Median (IQR)	3 (4-2)	2 (3-2)

Abbreviations: IQR, interquartile range; N (%), count (percentage); SD, standard deviation.

Table 2. Frequency of Patients According to—DM Service Following COVID-19 Pandemic Announcement.

Characteristics of service	Number of patients. n (%)[a]
Mode of consultation	
None[b]	3 (0.3)
Phone consultation	92 (10)
Face to face	538 (57.4)
Both	304 (32.4)
Type of intervention given	
Health education	665 (71.0)
Modification in drugs	318 (33.9)
Dietary counseling	240 (25.7)
Combined	172 (18.0)
Frequency of patients according to month interval	
First interval: (January-April)	87 (9.3)
Second interval: (May-August)	88 (9.4)
Third interval: (September-December)	762 (81.3)

[a]Percentage was calculated from a total of 937 patients received DM services following pandemic announcement in 2020.
[b]Patients were attended the healthcare facility for regular medication refill and refused consultation.

937 (93.7%) maintained to follow up for DM care during pandemic in 2020.

Median number of consultations between the two periods was 2 (IQR = 3-2) in 2020 versus 3 (IQR = 4-2) in 2019, $P = .000$ (Table 1).

Majority of patients received face-to-face consultation alone; 538 (57.4%), followed by combining face-to-face and telephone consultation in 304 (32.4%), and telephone consultation alone in 92 (10%) patients. Three (0.3%) did not receive any consultation, however, they presented in the health center for regular medication refill (Table 2).

Medical intervention was provided where 665 (71.0%) patients received health education, 318 (33.9%) had their medicines modified, 240 (25.7%) had dietary counseling, and 172 (18.0%) received all former interventions combined (Table 2).

The latest consultation for majority of patients was at the third interval, between September and December, where 762 (81.3%) patients received DM care. Similar number of consultations were seen at the first and second intervals: 87 (9.3%) between January and April and 88 (9.4%) from May to August.

The glycemic outcome for patients with diabetes (Difference in glycemic parameters before and after). Table 3 shows the mean values for HbA1c, LDL-cholesterol, BMI, systolic and diastolic blood pressure before and after. The difference in HbA1c was 0.2 ± 1.4 with 95% CI 0.1-0.3, $P = .000$. For other glycemic parameters, LDL-cholesterol increased by 0.04 ± 0.7 with 95% CI: -0.01 to 0.1, BMI increased by 0.2 ± 8.2 (95% CI: -0.4 to 0.9), and systolic blood pressure by 3.1 ± 0.7 (95% CI: 1.8-4.5), except for diastolic blood pressure which was -0.9 ± 12.4 (95% CI: -1.7 to -0.02) (Table 4)

The variation in glycemic outcome in relation to patients sociodemographic and clinical parameter was also evaluated. (Supplemental Table 2) There was a strong evidence an increase of HbA1c during pandemic among females, elderlies, and patients with diabetes duration of more than 5 years.

Secondary Objective

Association between glycated hemoglobin and mode of consultations after pandemic announcement in 2020. Table 5 shows the results from a multivariable linear regression model measuring the strength of association between HbA1c and mode of consultation, after adjusting for number of consultations and month of consultation during pandemic, duration of diabetes, age group, gender, presence of multimorbid,

Table 3. The Glycemic Parameters Result Before and After COVID-19 Pandemic Announcement for Patients With Diabetes in Mean ± SD and Count (Percentage).

	Before pandemic announcement in 2019	After pandemic announcement in 2020
Mean HbA1c (%) ± SD	7.5 ± 1.8	8.0 ± 2.0
Mean LDL-C (gm/dl) ± SD	2.5 ± 0.9	2.5 ± 1.0
Mean BMI (kg/m^2) ± SD	30.9 ± 6.3	31.0 ± 9.7
Mean systolic blood pressure (mmHg) ± SD	136 ± 18.5	139 ± 19.0
Mean diastolic blood pressure (mmHg) ± SD	77.0 ± 11.1	76.0 ± 11.1
Frequency of patients with CKD according to eGFR. N (%)		
≥90 (ml/min/1.73 m^2)	469 (46.9)	379 (40.4)
<90-60 (ml/min/1.73 m^2)	350 (35.0)	313 (3.4)
<60 (ml/min/1.73 m^2)	89 (8.9)	66 (7.0)

Abbreviations: HbA1c, glycated hemoglobin; IQR, interquartile range; LDL-C, low density lipoprotein cholesterol; N (%), frequency (percentage); SD, standard deviation.

Table 4. Mean Difference in Glycemic Parameters Before and After Pandemic Announcement With 95% CI and *P*-Value[a].

	Mean difference ± SD	95% CI	P-value
HbA1c (%)	0.2 ± 1.4	0.1 to 0.3	.000[b]
LDL-C (g/dl	0.04 ± 0.7	−0.01 to 0.1	.062
BMI (kg/m^2)	0.2 ± 8.2	− 0.4 to 0.9	.481
Systolic BP (mmHg)	3.1 ± 0.7	1.8 to 4.5	.000[b]
Diastolic BP (mmHg)	−0.9 ± 12.4	−1.7 to −0.02	.022[b]

Abbreviations: 95% CI, 95% confidence interval; BMI, body mass index; BP, blood pressure; HbA1c, glycated hemoglobin; LDL, low density lipoprotein cholesterol.
Level of significance *P*-value <.05.
[a]Paired *t*-test was used to test for the difference in glycemic parameters before and after pandemic announcement.
[b]Strong evidence for a difference was found as *P*-value was <.05.

and values of pre-pandemic HbA1c, LDL-cholesterol, eGFR, BMI, and blood pressure

The mean Glycated hemoglobin was lower by −0.3 (−2.3 to 1.6) among patients who received telephone consultation alone, −0.5 (−2.4 to 1.4) among face-to-face consultation alone, and −0.5 (−2.3 to 1.4) among patients who received face-to-face combined with telephone consultation, compared to those who did not receive any formal consultation, however, evidence for an association was unconvincing (Table 5).

We have also found an evidence of an association between post pandemic HbA1c and before pandemic glycemic parameter HbA1c, BMI, and duration of diabetes, after adjusting for pre-specified covariables. These factors are likely to have a positive association with HbA1c post pandemic. In fact, the relevant findings in Table 5 shows that with every 1 unit increase in HbA1c before pandemic, mean HbA1c increases by 0.8 (95% CI 0.7-0.9); with every 1-year increase in diabetes duration, mean HbA1c increases by 0.02 (95% CI: 0.003-0.040); and with every 1 kg/m^2 increase in BMI before pandemic, mean HbA1c increased by 0.02 (95% CI: 0.001-0.04)

Missing data. Supplemental Table 3 shows the frequency and percentage of missing data before and after pandemic announcement in 2019 and 2020, respectively. More data were missing during pandemic compared with data recorded before pandemic.

Sensitivity analysis. Supplemental Tables 4 and 5 display the means and difference in means for glycated hemoglobin after imputing missing value with the mean for before and after pandemic HbA1c. The difference was 0.3 ± 1.4 (95% CI 0.2-0.3), *P* = 0.000 with imputing versus 0.2 ± 1.4 (95% CI 0.1-0.3), *P* = .000 without imputing the missing value.

Mean difference in HbA1c and its association with face-to-face consultation in Muscat health center (n = 67) was 0.2 ± 1.2 (95% CI −0.05 to 0.50), *P* = .05, similar to crude analysis result. (Supplemental Tables 6 and 7)

Discussion

Approximately, 94.0% of patients who have attended DM clinic before pandemic continued to receive DM care after pandemic announcement. The access to basic diabetes care was maintained despite the interruption of standardized services and introduction of new means of consultation (phone consultation). The overall number of consultations during the pandemic declined. More than 80% of patients had their latest follow up visit during the third interval, between

Table 5. Linear Regression Analysis to Measure the Association Between Mean HbA1c and Mode of Consultation Following Covid-19 Pandemic Announcement After Adjusting for Multivariable[a].

HbA1c_2020	Coef.	Std. Err.	t	P > z	[95% Conf. Interval]
Mode of consultation					
1. Telephone	−0.34	0.99	−0.34	0.734	−2.3 to 1.6
2. Face to face	−0.50	0.96	−0.51	0.613	−2.4 to 1.4
3. Both	−0.50	0.96	−0.47	0.636	−2.3 to 1.4
Number of consultations in 2020	0.072	0.05	1.50	0.133	−0.02 to 0.12
Month interval during pandemic					
1st interval (January-April)	−0.30	0.27	−1.08	0.282	−0.81 to 0.24
2nd interval (May-August)	0.11	0.21	0.53	0.597	−0.23 to 0.52
Duration of diabetes	0.02	0.01	2.31	0.021	0.001 to 0.04
Age group in year					
36-59.9 (middle aged)	−0.21	0.32	−0.66	0.506	−0.83 to 0.41
≥60 (elders)	−0.20	0.33	−0.59	0.554	−0.85 to 0.45
Gender	−0.20	0.11	−1.72	0.086	−0.42 to 0.02
Multi-comorbid vs one morbidity	0.10	0.14	0.72	0.473	−0.18 to 0.38
HbA1c 2019	0.75	0.03	24.50	0.000	0.69 to 0.81
LDL 2019	0.004	0.06	0.07	0.942	−0.11 to 0.12
eGFR 2019	0.002	0.004	0.37	0.714	−0.008 to 0.011
BMI 2019	0.02	0.01	2.39	0.017	0.004 to 0.040
Systolic BP 2019	−0.005	0.004	−1.5	0.211	−0.012 to 0.003
Diastolic BP 2019	0.005	0.006	0.88	0.381	−0.01 to 0.02
_cons	1.74	1.18	1.48	0.139	−0.60 to 4.05

Abbreviations: BMI, body mass index (Kg/m^2); BP, blood pressure (mmHg); eGFR, estimated glomerular filtration rate ($ml/min/1.73\,m^2$); HbA1c, glycated hemoglobin (%); LDL, low density lipoprotein cholesterol (g/dl).
Level of significance *P*-value <.05.
_cons estimate baseline mean.
[a]Adjusting for number of consultations in 2020, period during pandemic, duration of diabetes, age groups, gender, presence, or absence of multi comorbidities, pre pandemic HbA1c, LDL, eGFR, BMI, systolic, and diastolic blood pressure.

September and December and 9.3% of patients followed up at first and second intervals, between January and April and May and August, respectively. Around 60% of patients had face-to-face consultation alone, 32% had combined face-to-face with phone consultations, and 10% had phone-based consultation. In terms of clinical management during the pandemic, majority of patients (71%) had health education on diabetes, and a quarter received dietary counseling by a dietician, besides the modification of medication for around 30% of patients who had uncontrolled disease.

Overall, the metabolic parameters including HbA1c, LDL-C, eGFR, systolic BP and BMI increased during the pandemic compared with pre-pandemic results, except for diastolic BP. There was a variation in HbA1c mean difference which was statistically significant. This reflects disparity from reduction to increase in level of glycemic control, among the study sample. A 0.2% decrease in HbA1c would lower mortality by 10% in patients with diabetes whereas a 1% increase is associated with 30% increase in all-cause mortality and 40% increase in cardiovascular mortality.[18] Therefore, it might be interesting and significantly essential to identify factors contributing to improving glycemic control in people living with diabetes during the pandemic. For blood pressure, the mean difference in systolic blood pressure was $3.1\,mmHg \pm 0.7$, *P* = .000, whereas mean diastolic blood pressure was reduced by $0.9\,mmHg \pm 12.4$, *P* = .002. However, this is unlikely to be clinically significant as there is a controversy on tight control of blood pressure in patients with diabetes, where studies suggest no improvement with aggressive control of blood pressure on cardiovascular outcome; adjusted HR, 1.15; 95% CI, 1.01-1.32; *P* = .04.[19]

Univariate analysis found a strong evidence for an association between the amount of HbA1c increase and mode of consultation in which increase in HbA1c was higher among those who received phone consultation alone compared with face-to-face and those with combined consultation. However, multivariable regression analysis showed a decrease in HbA1c in relation to mode of consultation after adjusting for age, gender, duration of diabetes, number of consultations in 2020, month intervals and metabolic parameters before pandemic, but the evidence was weak. Instead, a stronger association was found with pre-pandemic HbA1c and some evidence of an association with pre pandemic BMI and duration of diabetes.

The main limitation is missing data for metabolic parameters during pandemic and lack of information about reason for missingness. However, we expect that data missing is not related to the outcome of interest, therefore complete case analysis might not be biased. We only included patients who have been registered for DM care in DM clinic and did not include those who were registered at general practice visit, hence missed in this study, selection bias. Mental health status of patients is expected to be an important patient related factor that contributes to seeking healthcare, however it was not measured in our study due to lack information on patient psychology. Frequency of clinical intervention related to counseling and health education during the pandemic might be underreported as we usually experience in practice due to healthcare workload.

An international consensus published by Caballero et al[20] reporting about worldwide situation of patients with diabetes during COVID-19 pandemic, found an overall loss of glycemic control and increase in diabetes related complications. In China for example, accessibility to diabetes care was diminished and medication supply was affected. For that they introduced telemedicine services and provided medication supply center outside DM services centers which are in hospitals. In Latin America, there was a decline in number of consultations due to missed follow up visits as patients avoided visiting healthcare facilities, fearing from COVID-19 and its harm which also limited the access to medication and self-monitoring elements.[20] Our study showed that basic medical services for patients with diabetes were secured: medical consultations, supply of medication, counseling, and health education in primary care were still ongoing, despite the disruption of the standardized holistic approach and reduction in number of follow up visits. Telemedicine was utilized mainly through phone consultations, that was effectively used as an adjuvant to in person follow ups.[21]

A hospital-based study in Bahrain showed that the rates of face-to-face consultation declined with time during the pandemic and patients preferred phone consultations as they gained more trust with the new technology assisted system, however, the clinical outcomes were not measured.[15] In our study, phone consultation in Muscat governorate at primary care was frequently utilized as an adjunct to sustain patient follow up. Overall, using phone consultation reduced HbA1c by -0.34 (95% CI: -2.3 to 1.6), $P=.734$ versus -0.50 (95% CI: -2.4 to 1.4), $P=.613$ in face-to-face consultation and -0.50 (95% CI: -2.3 to 1.4), $P=.636$ with combined methods consultation. However, judging the effectiveness of a new healthcare service within a 12-month period might be inefficient, especially in a time full of obstacles, where health workforce was mobilized toward COVID-19 services and patients had to adapt with the new intervention that was not yet standardized. Meanwhile, the Directorate of Primary Care of Muscat governorate in collaboration with the WHO, Bloomberg, and Vital Strategies is working on launching a standardized well-established telemedicine communication services in primary care.[22]

A systematic review and network meta-analysis found that telemedicine reduced HbA1c by a mean of 0.43% (95% CI: -0.64% to -0.21%).[23] We found an effect of 0.34% reduction with phone based follow up, however, the findings were statistically inconclusive. This could be due to large proportion of missing values for metabolic parameters in this study.

The results of this study are generalizable as patients with various comorbid disease were included ensuring the representativeness of study population. Results from sensitivity analysis reflects the low impact of missing data on the estimate of interest. The values of glycated hemoglobin did not change compared to complete case analysis. Patients from Muscat health center who had face to face consultations only, did not have a better outcome compared to other patients who received various mode of consultation.

Conclusion

DM services were accessible in primary care during COVID-19 pandemic as majority of patients maintained to follow up in 2020, despite disruption of comprehensive care. After adjusting for multivariable, HbA1c decreased in association with mode of consultation including phone consultation, however evidence was inconclusive.

Authors Contributions

The study concept was developed by HA who was supervising and guiding throughout the study project. Data collection, cleaning & management, analysis, and paper writing was undertaken by TA. AL was leading the team and contributed in data collection, paper writing and submission for publication. All authors contributed in sharing ideas and information, data collection, interpreting & revising the results, and approving the final version of the manuscript.

Declaration of Conflicting Interests

The author(s) declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

Research Ethics

The study was approved by the Regional Research and Ethics Committee at the Ministry of Health Oman, proposal ID: MoH/CSR/20/24390.

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