Determinants of Glycemic Control in the Philippines

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Introduction. Glycemic control in the Philippines has increased from 15% in 2008 to 47.4% in 2020. This study aims to identify the determinants of glycemic control in the Philippines.

Methodology. This study included patients with type 2 diabetes mellitus. Current glycated hemoglobin (HbA1c) levels, medication compliance and adherence, and the clinico-socio-demographic profile of diabetics in the Philippines were recorded.

Results. There was no significant association between glycemic control and clinico-socio-demographic characteristics or medication compliance. However, the absence of complications showed a statistically significant positive association (odds ratio [OR], 1.65; p=0.02). While intensification of management provided a statistically significant reduction in HbA1c levels, no statistically significant association was observed. There was a statistically significant positive association with a diabetes duration of <7 years (OR, 2.692; p<0.0001). Observing a significant positive association would take 9 months of treatment (OR, 1.978; p=0.02).

Discussion. Diabetes duration of <7 years and absence of complications had a statistically significant impact on improving glycemic control. Although intensifying management led to a notable reduction in HbA1c levels, no statistically significant correlation was observed. The duration of management exhibited a curvilinear relationship with glycemic control, showing optimal glycemic control beginning at 9 months of duration, peaking at 1 year, and declining at 4 years of management.

Keywords. *blood sugar, diabetes, Philippines*

Introduction

Diabetes mellitus is a significant health issue worldwide, affecting more than 537 million people globally, with a prevalence of 9.8% in 2021.[1] It is the fourth most common cause of death among Filipinos.[2] The latest Philippine National Health and Nutrition survey conducted in 2018 reported a prevalence of 7.9%, closely matching the 2019 International Diabetes Federation Diabetes Atlas prevalence of 6.3%.[3] The National Health and Nutrition survey clearly showed an increasing trend, from 3.9% in 1998, 4.8% in 2008, to 5.4% in 2013 and 7.9 % in 2018.[4]

There was a marked improvement in the diabetes care situation in the Philippines from the 2008 study to the 2020 study. Glycemic control defined at HbA1c level of <7.0 increased from 15% in 2008 to 47.4% in 2020.[5] This

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population-based cross-sectional study aims to identify the determinants of glycemic control in the Philippines.

Methodology

Study Design

This research manuscript presents a population-based cross-sectional study conducted to assess the current status of diabetes care in the Philippines. The study was designed in compliance with various guidelines and recommendations for good epidemiological practice for non-interventional studies, including the Philippine Health Research Ethics Board 2017 Guidelines for the Conduct of Research on Human Participants and the International Conference on Harmonization Good Clinical Practice Guidelines. Ethical clearance was obtained from the University of the East Ramon Magsaysay Memorial Medical Center, Inc., Research Institute for Health Science Ethics Review Committee, ensuring adherence to the Data Privacy Act of 2013.

Subject Recruitment and Data Collection

Eligible subjects were required to provide informed consent, during their latest visit to the clinic, to permit access to their medical records. A thorough review of the clinical records was conducted to collect relevant data and complete the case report form. The study aimed to identify the determinants of glycemic control in the Philippines, using the American Diabetes Association (ADA) guideline of HbA1c levels <7% as the primary endpoint. The following factors were assessed for their association with glycemic control: clinical and socio-demographic characteristics, diabetic complications, management intensification, and medication compliance.

The study included patients diagnosed with diabetes mellitus for at least 1 year, who received care from the clinics of the Institute for Studies on Diabetes Foundation, Inc. (ISDFI) Doctors after completing courses at the ISDFI. These patients voluntarily participated in the study, and data collection took place from January 2020 to June 2020. To ensure unbiased sampling, eligible patients were anonymized and randomly selected using simple random sampling.

Inclusion and Exclusion Criteria

The study enrolled adult patients between the ages of 18 and 80 who had been diagnosed with type 2 diabetes mellitus for at least 1 year and had received care from ISDFI doctors for a minimum of 1 year. Pregnant individuals, patients with end-stage renal disease who were currently undergoing dialysis, those hospitalized within 3 months prior to the study, and terminally ill patients, including individuals with malignancy or undergoing cancer treatment, were excluded from the study.

Sample Size Calculation

The minimum required sample size was determined based on the results of the DiabCare 2008 study by Jimeno et al., which reported that 85% of patients did not achieve glycemic control. Using a confidence level of 95% and a 5% confidence limit, the sample size was calculated to be 196 subjects using the Epi Info sample size calculator.

Data Collection and Analysis

To evaluate the status of each participant, three sets of HbA1c results were documented following ADA guidelines. These sets included the most recent results and those obtained 3 and 6 months after the initial consultation with the physician. Both laboratory-based testing and point-of-care (POC) system results were accepted, provided they were obtained from the same laboratory or the same POC system to ensure standardized reference for HbA1c results per patient.

Descriptive statistics were used to summarize continuous variables, including the number of observations (N), mean, standard deviation, minimum, and maximum. For discrete variables, summary statistics were presented in terms of absolute and relative frequencies. Statistical analysis of the data was performed using IBM SPSS software.

Patient demographic data were described using absolute and relative frequencies for categorical variables, and mean, standard deviation, minimum, and maximum values for continuous variables. To determine the determinants of glycemic control, odds ratios (ORs) were computed to assess the association, and the chi-square test was used to determine statistical significance, accompanied by a 95% confidence interval (CI). A significance level of $p<0.05$ was set for all analyses.

Results

Clinico-Socio Demographic Profile

A total of 340 patients were included in the study: 255 (75%) were from Luzon, 39 (11.5%) were from Visayas, and 46 (13.5%) were from Mindanao.

Clinico-Socio Demographic Parametes

Patients' ages ranged from 27 to 80 years, with the mean age of 61.61 ± 9.96. There were more female than male patients. Majority had tertiary education (n=230; 67.6%) and were not working (58.8%). The patients' body mass indexes (BMIs) had a range of 17.7–39.64, with the mean of 25.86 ± 3.78 (Table 1).

Table 1. Clinico-socio demographic profile

Clinico-socio-demographic parameter	**Descriptive statistics**	
Age	Mean=61.61	SD=9.96
Age group (years)	**Frequency (n=340)**	**Percentage**
Young adult (18–39)	9	2.6%
Middle aged adult (40–59)	104	30.6%
Old Adult (60–80)	227	66.8%
Gender	**Frequency (n=340)**	**Percentage**
Male	113	33.2%
Female	227	66.8%
Educational attainment	**Frequency (n=340)**	**Percentage**
Primary	23	6.8%
Secondary	87	25.6%
Tertiary	230	67.6%
Working status	**Frequency (n=340)**	**Percentage**
Yes	140	41.2%
No	200	58.8%
Income	**Frequency (n=140)**	**Percentage**
Below minimum	3	2.1%
Minimum	46	32.9%
Above minimum	91	65.0%
BMI	Mean=25.86	SD=3.78
BMI classification	**Frequency (n=324)**	**Percentage**
Normal (18.5–22.9)	70	21.6%
Underweight (<18.5)	3	0.9%
Overweight (23–24.9)	69	21.3%
Obese (≥25)	182	56.2%

Patient's Compliance to Medication

A total of 335 patients responded to the Brief Medication Questionnaire, and only 318 patients had available data that could be used to assess their compliance with their prescribed medications. From this sample, the majority of the patients (n=203; 63.8%) were compliant.

Glycemic Control Assessment (HbA1c)

HbA1c result from three time points (initial consult, 3 months and 6 months) were taken for each patient. A standard value of less than 7% HbA1c indicated desired glycemic control. At 6 months after the initial consult, the range of HbA1c is 3.81 to 12.70 with a mean of 7.23 ± 1.30. A total of 161 patients or 47.4% achieved glycemic control with less than 7% HbA1c.

Determinants of Glycemic Control

Association of Glycemic Control and Clinico-Socio-Demographic Characteristics

While a higher number of middle-aged and older adults achieved glycemic control, the results were not statistically significant. No association between glycemic control and gender, working status, or presence of comorbidities (Table 2).

Table 2: Associations of clinico-socio demographics and glycemic control

Determinants	Target glycemic control (HbA1c <7% at 6 months)	Not in target glycemic control (HbA1c ≥7% at 6 months)	Odds ratio (95% CI)	P-value
Age group				0.188
Young adults (n=9)	7 (77.8%)	2 (22.2%)	1.00	0.225
Middle-aged adults (n=104)	49 (47.1%)	55 (52.9%)	3.929 (0.779–19.811)	0.097
Older adults (n =227)	105 (46.3%)	122 (53.7%)	4.067 (0.827–20.001)	0.084
Gender			1.026 (0.653–1.613)	1.000
Male (n=113)	54 (47.8%)	59 (52.2%)		
Female (n =227)	107 (47.1%)	120 (52.9%)		
Educational attainment				0.598
Primary (n=23)	13 (56.5%)	10 (43.5%)	1.00	0.610
Secondary (n=87)	39 (44.8%)	48 (55.2%)	1.600 (0.634–4.041)	0.320
Tertiary (n=230)	109 (47.4%)	121 (52.6%)	1.443 (0.608–3.424)	0.405
Working status			0.966 (0.627–1.489)	0.927
Not working (n=200)	94 (47.0%)	106 (53.0%)		
Working (n 140)	67 (47.9%)	73 (52.1%)		
Income classification				0.644
Minimum (n=46)	20 (43.5%)	26 (56.5%)	1.00	0.654
Below minimum (n=3)	2 (66.7%)	1 (33.3%)	0.385 (0.033–4.548)	0.448
Above minimum (n=91)	45 (49.5%)	46 (50.5%)	0.786 (0.385–1.605)	0.509
Presence of co-morbidities				
Without co-morbidities	18 (48.6%)	16 (47.1%)	1.28 (0.63–2.61)	0.492
(n=37)	143 (47.2%)	163 (53.3%)		
With co-morbidities (n=303)				
With co-morbidities				
1 co-morbidity (n=96)	47 (49.0%)	49 (51.0%)	1.00	
2 co-morbidities (n=122)	60 (49.2%)	62 (50.8%)	0.991 (0.581–1.692)	0.974
3 co-morbidities (n=54)	21 (38.9%)	33 (61.1%)	1.507 (0.765–2.969)	0.235
>3 co-morbidities (n=31)	15 (48.4%)	16 (51.6%)	1.023 (0.455–2.058)	0.956
Hypertension				0.6885
With	105	113	1.095 (0.7086–1.702)	
Without	56	66		
Dyslipidemia				0.1639
With	86	109	0.7364	
Without	75	70	0.4746–1.137	
BMI				**BMI**
Normal	35 (50%)	35 (50%)	1.00	Normal
Overweight	29 (42%)	40 (58%)	1.379 (0.6882–2.643)	Overweig
Obese	88(48%)	94(52%)	1.068 (0.6108–1.869)	ht
				Obese

Table 3: Association of DM Complications and Glycemic Control

Determinant	Target glycemic control (HbA1c <7% at 6months)	Not in target glycemic control (HbA1c ≥7% at 6months)	Odds ratio (95% CI)	P-value
Presence of DM Complications				
Without Complications (n=163)	92 (53.5%)	80 (46.5%)	1.650 (1.07–2.54)	0.022
With Complications (n=140)	69 (41.1%)	99 (58.9%)		

Association of Glycemic Control and DM Complications

There was a statistically significant (p=0.022) association between glycemic control and the presence of complications, with better glycemic control observed in those without complications. The OR for this association was 1.650, with a CI of 1.07 to 2.54 (Table 3).

Effect of Intensification to HbA1c

The study further tried to determine the effect of management intensification with glycemic control. The study also aimed to assess the impact of intensifying management on glycemic control. Intensification is defined as either increasing dosage of current treatment or modifying the treatment regimen by adding or switching medications at any point from the initial consultation up to 6 months.

Out of 340 patients, 45 patients, or 13.2%, did not undergo management intensification but successfully maintained their HbA1c within the target glycemic control range at all three timepoints.

For the remaining 295 patients, or 86.8%, the effect of management intensification with glycemic control showed that there is a statistically significant difference between glycemic control and intensification (within subjects, p<0.0001; between subjects, p=0.006). Mean HbA1c levels of patients with management intensification are statistically lower as compared to patients without management intensification (Table 4).

Table 4. Effect of management intensification and glycemic control

	HbA1c at initial	**HbA1c at 3 months**	**HbA1c at 6 months**	**P-value**
Without intensification	μ=8.40 (SD ± 2.10)	μ=8.23 (SD ± 1.77)	μ=7.79 (SD ± 1.28)	<0.0001
With intensification	μ=7.87 (SD ± 1.65)	μ=7.50 (SD ± 1.28)	μ=7.35 (SD ± 1.27)	

Table 5. Association of intensification to glycemic control

	With glycemic control	**Without glycemic control**	**OR**	**P-value**
With intensification	146	151	1.805 (0.9346 to 3.422)	0.0797
Without intensification	15	28		

For patients that had management intensification, pairwise comparison also showed a statistically significant difference between two specified timepoints. Initial mean HbA1c as compared to mean HbA1c after 3 months showed a significant p=0.021, whereas mean Hba1c at initial visit versus mean HbA1c at 6 months has a significant p<0.0001. Comparing the mean HbA1c levels at 3 months versus 6 months also showed a significant p=0.002.

Association of Intensification to Glycemic Control

Although the analysis shows a positive association between intensification and glycemic control with a coefficient of 1.805, the results are not statistically significant (Table 5).

Association of Patient Medication compliance to Glycemic control

Glycemic control at 6 months was also compared with the results of the Brief Medication Questionnaire. The results showed no statistically significant association between patients' compliance with medication and glycemic control (Table 6).

Table 6. Association of patients' medication compliance and glycemic control

	Glycemic control	**Without glycemic control**	**P-value**	**Odds Ratio (95% CI)**
Non-compliant (n=115)	55	60	0.815	0.922 (0.583–1.459)
Compliant (n=203)	93	110		

Association of Duration of Diabetes and Glycemic control

Pearson r correlation of the duration of diabetes and HbA1c value at 6 months showed that there is a low statistically significant positive correlation with the duration of diabetes and HbA1c value (r=0.220; 0.1696–0.3686; p<0.0001). There is a statistically significant positive association between duration of diabetes and glycemic control (OR, 2.692; p<0.0001; Table 7).

Association of Duration of Management and Glycemic Control

The data indicates a curvilinear relationship between the duration of management and glycemic control. A statistically significant positive association is observed after 9 months of treatment (OR, 1.978; p=0.02), with the strongest association at 1 year (OR, 2.059; p=0.01). However, after 3 years, the association diminishes, and it eventually becomes negative after 4 years of management (Table 8).

Table 7. Association of duration of diabetes and glycemic control

	With glycemic control	Without glycemic control	OR	P-value
Duration ≤7 years	69	39	2.692 1.665 to 4.368	<0.0001
Duration ≥8 years	92	140		

Table 8. Association of duration of management and glycemic control

Duration of management	**With glycemic control**	**Without glycemic control**	**OR**	**P-value**
6 months	147	152	1.865 0.9375–3.704	0.0709
<6 months	14	27		
9 months onward	141	139	1.978 1.088–3.562	0.0214
<9 months	20	39		
≥1 year	140	136	2.059 1.163–3.596	0.0126
<1 year	21	42		
2 years	113	106	1.599 1.026–2.537	0.0409
<2 years	48	72		
≥3 years	88	91	1.062 0.7046–1.601	0.7733
<3 years	92	101		
≥4 years	66	77	0.9113 0.5869–1.410	0.6733
<4 years	95	101		

Discussion

Clinico-Socio Demographic Characteristics

The clinico-socio demographic characteristics of Filipino patients with diabetes in our study were consistent with previously published studies. The age range of the patients was 27–80 years, with a mean age of 61.61 (± 9.96). There was a higher proportion of female patients (66.8%) compared to male patients (33.2%). The majority of the patients had tertiary education (67.6%), and a significant number were not working (58.8%). The participants' BMIs ranged from 17.7 to 39.64, with a mean of 25.86 ± 3.78. These findings are similar to the 2008 DiabCare study, which reported a mean age of 61.56 (SD, 11.3 years), with 67.4% women and a mean BMI of 25.72.[6]

Comparisons with other Asian countries revealed similarities with Indonesia, where the mean age was 58.4 ± 9.5 years, female preponderance was 58.6%, and BMI was 25.2 ± 4.2.[7] The Centers for Disease Control and Prevention also reported higher incidence rates of diagnosed diabetes among adults aged 45–64 years and those aged 65 and older.[8] A Chinese study showed a mean age of 56.8 ± 13.5 years and a mean BMI of 25.1 ±

4.0, while Vietnam had a mean age of 62.7 years with 58.9% women.[9]

Glycemic Control

Our study demonstrated better glycemic control compared to the 2008 DiabCare study, with 47.4% of patients achieving an HbA1c level of <7%. In contrast, only 15% of patients in the 2008 study were able to achieve this target.[6] When compared with other countries and regions, the proportion of patients achieving HbA1c <7% after 12 months varied: 32.7% for Europe, 20.4% for India, 43% for the Middle East, 42% for Latin America, and 19.0% for East Asia.[10] Data from neighboring countries in the Western Pacific region also showed varying proportions: 36.1% for Vietnam (2019), 23.4% for India (2019), 30.2% for Thailand (2006), 33.0% for Singapore (1998), 39.7% for Hong Kong (2008), and 43.5% for South Korea (2009).[10-15] Taking into account the timing of the studies and differences in the selected populations, our research indicated improved glycemic control among the Filipino population compared to previous studies. This improvement is likely due to the introduction of newer, more effective, and safer diabetes medications, updated diabetes management guidelines, better adherence, and reduced clinical inertia.

Determinants of Glycemic Control

Socio-Demographic Factors and Glycemic Control

In this study, none of the socio-demographic determinants showed a statistically significant association with glycemic control status at 6 months after the initial consultation. This contrasts with other studies that have shown the effects of sociodemographic factors such as age and BMI on glycemic control.[12,16-20] Although there were higher odds of glycemic control among older (OR, 4.0) and middle-aged adults (OR, 3.9) compared to young adults, the results were not statistically significant.

Complications and Glycemic Control

This study identified a statistically significant positive correlation (p=0.011) between inadequate glycemic control and diabetes-related complications. This is consistent with the results of landmark studies that have shown a strong association between the two.[21,22] Tight glycemic control has been shown to benefit in the reduction of microvascular complications, as supported by both short and long-term studies.

Glycemic Control and Intensification

Intensification of management had a statistically significant effect on the value of HbA1c (within subjects, p<0.0001; between subjects, p=0.006). Patients with management intensification had statistically lower mean HbA1c levels than patients without management intensification. However, although there was a positive association between intensification and glycemic control, the result was not statistically significant.

It is important to note that diabetes is a chronic disease associated with high economic and health burdens due to the incidence of complications and mortality. Optimizing metabolic control through multifactorial intervention has been shown to reduce this burden.[23,24] Prompt and appropriate intensification of blood glucose management is crucial for achieving metabolic targets and preventing clinical inertia, which can impede effective diabetes management and its associated complications.

Medication Adherence and Compliance

In our study, 63.8% of patients were compliant with their medications. While the 2008 study did not reflect compliance to treatment, the 2012 study in Indonesia showed similar results with 73.5% adhering to their prescribed medications.[7] In China, only half of patients adhered to diet and exercise recommendations.[25] Three-quarters fully complied with prescribed medication, while almost one-fifth of patients said they never followed treatment recommendations from doctors or nurses.

However, there was no statistically significant association between patients' medication compliance and glycemic control in our results. Previous studies from government tertiary care hospitals in India, which provide free medication coverage, observed a high prevalence of poor glycemic control despite good anti-diabetes medication adherence rates in patients.[26] Although adherence and compliance should lead to better glycemic control, lack of adherence to therapy can cause suboptimal glycemic control, leading to treatment failure and increased morbidity and mortality from diabetes complications. It is possible that the better glycemic control rate observed in our study is due to the good intensification practices of the attending physicians.

Duration of Diabetes and Glycemic Control

The data showed that the longer the duration of diabetes, the higher the HbA1c value at 6 months after treatment. It also found that glycemic control is 2.70 times better for those with diabetes duration of 7 years or less, and this result is statistically significant. This aligns with the findings of other studies that demonstrate a longer duration of diabetes as a determinant of poor glycemic control.[21,27-29]

Duration of Management

The data demonstrated a curvilinear relationship between the duration of management and glycemic control. Glycemic control is typically achieved after at least 9 months of management, peaking at 1 year. However, no association is observed at 3 years, and a negative association appears after 4 years. This finding is noteworthy as previous studies have not examined the impact of management duration on glycemic control.

Limitations

An important limitation is the reliance on self-reported medication adherence, which can lead to reporting bias as patients might exaggerate their adherence. Additionally, the cross-sectional design of the study limits the ability to determine causal relationships between glycemic control and various factors, possibly leaving some confounding variables unaddressed. The sample

was taken from a specific group receiving care at ISDFI clinics, which may not represent the broader diabetic population in the Philippines, potentially impacting the generalizability of the findings. Furthermore, while the study identified statistically significant associations between the duration of diabetes and glycemic control, these results might not fully capture the complexity of diabetes management, including factors like patient motivation and interactions with healthcare providers, which could also influence outcomes.

Conclusion

In this study, the percentage of patients achieving glycemic control (HbA1c <7.0) increased from 15% to 47.4%. No statistically significant link was found between clinical-socio-demographic factors and glycemic control. However, patients with a diabetes duration of 7 years or less showed significantly better glycemic control. There was also a significant association between glycemic control and the presence of complications. While management intensification led to a reduction in HbA1c levels, this did not reach statistical significance. The duration of management had a curvilinear relationship with glycemic control, with optimal control beginning at 9 months, peaking at 1 year, and declining after 4 years.

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