

A Study to Assess the Association Between the Hba1c Variability and Hypoglycemia Related Hospitalization Among Patient with Type 2 Diabetes Mellitus

¹Mrs.K. Karpagam, ²Atchaya. A

¹Department of Medical and Surgical Nursing,
Saveetha College of Nursing, Saveetha Institute of Medical and Technical Sciences,
Saveetha University, Thandalam, Chennai, TamilNadu

Email: karpagaraja1982@gmail.com

²Bsc Nursing IVyear, Saveetha College of Nursing, Saveetha Institute of Medical and Technical Sciences, Saveetha University, Thandalam, Chennai, TamilNadu

Email: ammuatchaya4@gmail.com

Abstract

Introduction: The chronic multisystem disease known as diabetes mellitus is caused by either inadequate insulin utilisation or abnormal insulin production. Worldwide, diabetes mellitus is a serious health issue whose incidence is rapidly rising. Diabetes affects an estimated 40 million Indians. The prevalence is about 9% in urban areas and 3% in rural areas. Diabetes has emerged as a major public health concern in India. According to the World Health Organization, our country had 31.7 million diabetics in 2000, and that number is expected to rise to 71.4 million by 2030. Hypoglycemia is a serious side effect of diabetes treatment. The gold standard for assessing glycemic control in diabetic patients is the measurement of glycosylated hemoglobin Hb A1c (A1C). Glycemic management optimization necessitates a delicate balancing act that allows patients to achieve their target HbA1C while avoiding hypoglycemia. **Aims:** The aim of the A study to assess the association between the HbA1c variability and hypoglycemia related hospitalization with type 2 diabetes mellitus. **Subjects and Design:** The Quantitative research approach was adopted for this study and descriptive research design used population of the study comprised of clients with hypoglycemia related hospitalization with type 2 diabetes mellitus admitted at Saveetha Medical College & Hospital. The sample size of the study comprises of 30 clients. The purposive sampling technique was used. **Statistical Analysis:** The continuous blood glucose levels and HbA1c levels are collected. The collected data were analysed using descriptive and inferential statistics. Karl Pearson's Correlation was used to correlate the HbA1c variability and hypoglycaemia among clients with type 2 diabetes mellitus. Chi-square was used to analyse the association of level of HbA1c variability and hypoglycaemia among clients with type 2 diabetes mellitus. **Results:** The major result findings clearly infers the calculated Karl Pearson's Correlation value of $r = -0.777$ between HbA1c variability Vs capillary Blood glucose level shows a strong negative correlation which clearly infers that when HbA1c variability increases then CBG level decreases which ultimately shows the possibility of patients getting hypoglycemia. and when the HbA1c increases / decreases then ultimately Serum creatinine and Serum albumin level also increases / decreases. The HbA1c level is a predictor for risk of hypoglycaemia. **Conclusion:** The increasing HbA1c levels variability and elevated HbA1c are associated with a greater risk of hypoglycaemia.

Keywords: Type 2 diabetes mellitus, Hypoglycemia, HbA1C Variability.

1. Introduction

The chronic multisystem disease known as diabetes mellitus is caused by either inadequate insulin utilisation or abnormal insulin production. Worldwide, diabetes mellitus is a serious health issue whose incidence is rapidly rising. Diabetes affects an estimated 40 million Indians. The prevalence is about 9% in urban areas and 3% in rural areas.

Diabetes's devastating long-term complications are what make it so devastating. Adult blindness, end-stage renal disease (ESRD), and non-traumatic limb amputations are primarily brought on by diabetes. The goals of diabetes management are to ease

symptoms, improve health, and avoid complications. The tools used in diabetes management include self-monitoring of blood glucose, nutrition therapy, medication, exercise, and collaborative management.

The two major types of glucose-lowering agents used in the treatment are insulin and oral agents. The major complication of administering insulin and drugs are Hypoglycemia. The early symptoms of hypoglycemia is sweating, tremor, pallor, tachycardia, palpitations nervousness from the release of adrenalin when glucose falls rapidly.

The later symptoms of hypoglycemia light-

headedness, head ache, confusion, irritability, slurred speech, lack of coordination, staggering gait from depression of central nervous system as glucose level progressively falls.

Hypoglycemia is a serious side effect of diabetes treatment. While mild hypoglycemia creates unpleasant symptoms and interferes with patients' normal activities, severe hypoglycemia can lead to coma, seizures, and death. Recurrent episodes of mild hypoglycemia can also modify the counterregulatory response to lower blood glucose levels, leading to hypoglycemia unawareness, putting patients at risk for severe hypoglycemia. The gold standard for assessing glycemic control in diabetic patients is the measurement of glycated haemoglobin A1c (A1C). The rate of synthesis of HbA1c is directly related to the exposure of RBC to glucose. HbA1c reflects the mean blood glucose level over 2 months periods prior to its measurement. Glycemic management optimization necessitates a delicate balancing act that allows patients to achieve their target A1C while avoiding hypoglycemia.

Both the American Diabetes Association (ADA) and the International Diabetes Federation (IDF) promote self-management as an important part of diabetes treatment. Because of the requisite lifestyle adjustments, such as eating habits, body weight, exercise, and blood glucose self-monitoring, good T2DM control is typically difficult to attain.

The goal of diabetes management to remind sugar level in blood while adjacent to normal. diabetes management it contains dietary management, examine of blood sugar level, maintenance of weight. In nutrition management healthy carbohydrates and sugar starch are helps in absorption. And high fiber content is present in vegetarian foods and dry fruits. The lifestyle modification includes increasing physical activity, improving diet, reaching a healthy body weight, and stopping smoking¹⁴.

Diabetes medication includes insulin and sulfonylureas are among the most common causes of hypoglycemia in diabetes mellitus the longer acting sulfonylurea's such as glibenclamide and chlorpropamide are associated with more severe hypoglycemia than the shorter acting drugs metformin was the most frequent used oral hypoglycemic agent followed by sulfonylureas and the most prevalent combination therapy was metformin and glibenclamide¹⁵.

The purpose of the study (1)To assess the HbA1c variability and hypoglycemia related hospitalization among clients with type 2 diabetes mellitus. (2)To correlate the HbA1c variability and hypoglycemia related hospitalization among clients with type 2 diabetes mellitus (3) To associate the HbA1c variability and hypoglycemia related hospitalization among clients with type2 diabetes mellitus with their selected demographic variables.

2. Methods and Materials

Quantitative research approach was adopted for this study to accomplish the objectives of the study. The research design used for this study was descriptive research design. The study was conducted at Saveetha Medical College & Hospital, Chennai . Sample are the diabetes clients who fulfil the inclusion criteria .The sample size for this study is 30. The criteria for sample selection are Clients who are in the age group of 30 – 60 years, Both the genders are included, Clients who were willing to participate in the study, Clients with diabetes for a period of 1 year and above and newly diagnosed with diabetes Clients with the treatment of insulin and oral hypoglycemia agent or both. The samples for the present study were selected by purposive sampling technique method. The data collection was done with prior permission from the Medical superintendent and ethical clearance was obtained from the institution. The purpose of the study was explained to the Participants. The Structured interview questionnaire used to assess the demographic variables of client with diabetes. The capillary blood glucose levels and HbA1c levels are collected . The collected data were analysed using descriptive and inferential statistics. The Frequency and percentage distribution were used to analyse the demographic variables. Mean and standard deviation was used to assess the relationship between HbA1c variability and hypoglycaemia among clients with type 2 diabetes mellitus. KarlPearson's Correlation was used to correlate the HbA1c variability and hypoglycaemia among clients with type 2 diabetes mellitus. Chi-square was used to analyse the association of level of HbA1c variability and hypoglycaemia among clients with type 2 diabetes mellitus [39].

3. Results and Discussion

SECTION A: Description of the demographic variables of clients with type 2 diabetes mellitus

Demographic variables shows that most of the clients with type 2 diabetes mellitus 30(100%) had type II diabetes mellitus, 14(46.7%) had type 2 diabetes mellitus for 0 – 3 years, 18(60%) had no family history of type 2 diabetes mellitus, 24(80%) had no past medical history, 21(70%) had regular monthly clinical visits, 17(56.6%) were using insulin as diabetes medication, 39(100%) were having diabetes medications regularly and 19(63.4%) had no habits.

Frequency percentage distribution of HbA1c level among Diabetic clients shows that most of the clients with type 2 diabetes mellitus, 16(53.3%) had HbA1c (%) <6, 19(63.3%) had serum creatinine level in the range of 0.6 – 1.2 mg/dL and 17(56.7%) had serum albumin <3.5 gm/dL.

Demographic Variables	F	%
Age (in years)		
40 – 50	8	26.7
51 – 60	6	20.0
61 – 70	9	30.0
More than 70	7	23.3
Gender		
Male	18	60.0
Female	12	40.0
Religion		
Hindu	15	50.0
Christian	12	40.0
Muslim	3	10.0
Others	-	-
Educational status		
No formal education	5	16.7
Primary education	9	30.0
Secondary education	11	36.6
Diploma / Graduate	5	16.7
Occupational status		
Daily wages	12	40.0
Government employee	9	30.0
Private employee	9	30.0
Unemployment	-	-
Residence		
Urban	26	86.7
Rural	4	13.3
Marital status		
Married	22	73.4
Unmarried	3	10.0
Divorced	1	3.3
Widowed	4	13.3
Economic status		
Upper class	7	23.3
Middle class	13	43.4
Lower class	10	33.3
Type of family		
Nuclear family	15	50.0
Joint family	12	40.0
Extended family	3	10.0
Dietary habit		
Vegetarian	14	46.7
Non-vegetarian	16	53.3

Clinical Variables	F	%
Type of diabetes mellitus		
Type I diabetes mellitus	-	-
Type II diabetes mellitus	30	100.0
History of type 2 diabetes mellitus		
0 – 3 years	14	46.7
4 – 6 years	11	36.7
7 – 10 years	4	13.3
Above 10 years	1	3.3
Family history of type 2 diabetes mellitus		
Yes	12	40.0
No	18	60.0
Past medical history		
Hypertension	4	13.3
Cardiovascular disease	-	-
Renal failure	2	6.7
None	24	80.0
Regular clinical visits		
Monthly	21	70.0
3 months once	6	30.0
6 months once	3	10.0
Annually	-	-
Diabetes medication usage		
Insulin	17	56.6
Metformin	5	16.7
Sulfonylurea	5	16.7
Thiazolidinediones	3	10.0
Having diabetes medications regularly		
Yes	30	100.0
No	-	-
Type of habits		
Smoking	7	23.3
Alcohol consumption	2	6.7
Both smoking and alcohol consumption	4	13.3
None	19	63.4

The table 2 shows that most of the clients with type 2 diabetes mellitus, 30(100%) had type II diabetes mellitus, 14(46.7%) had type 2 diabetes

mellitus for 0 – 3 years, 18(60%) had no family history of type 2 diabetes mellitus, 24(80%) had no past medical history, 21(70%) had regular

monthly clinical visits, 17(56.6%) were using insulin as diabetes medication, 39(100%) were having diabetes medications regularly and 19(63.4%) had no habits.

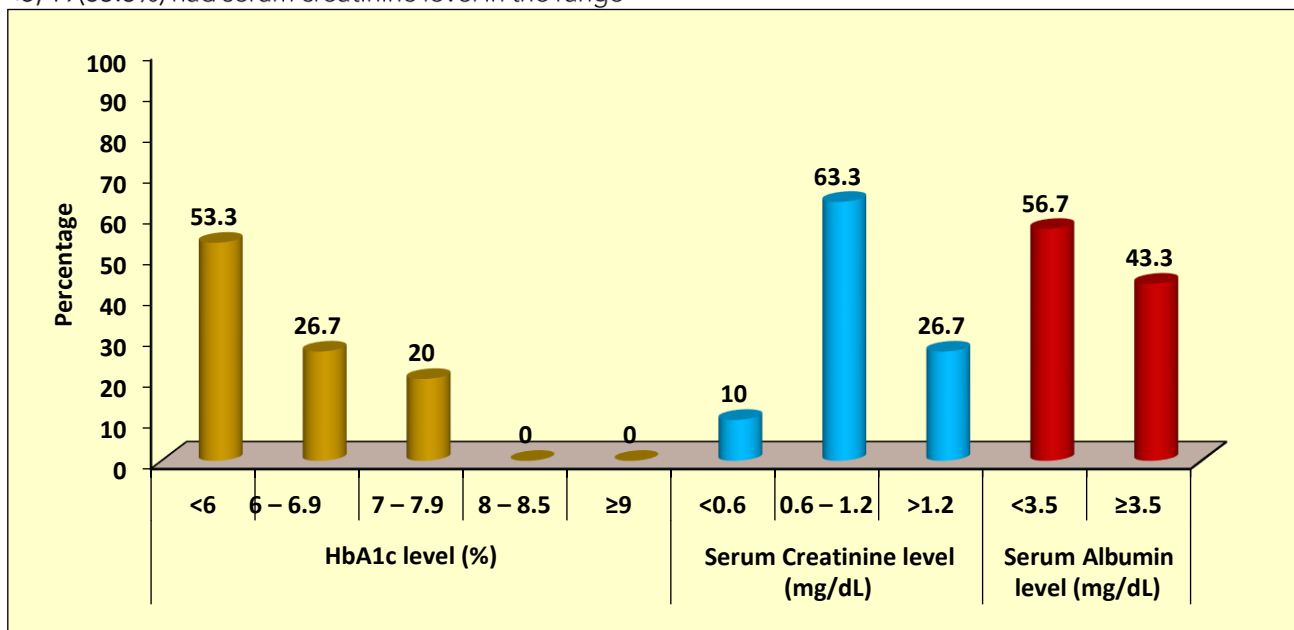
SECTION B: Assessment of level of HbA1c variability and hypoglycemia among clients with type 2 diabetes mellitus.

Table 3: Frequency and percentage distribution of level of HbA1c variability and hypoglycemia among clients with type 2 diabetes mellitus. n = 30

Variables	Frequency	Percentage
HbA1c level (%)		
<6	16	53.3
6 – 6.9	8	26.7
7 – 7.9	6	20.0
8 – 8.5	-	-
≥9	-	-
Serum creatinine level (mg/dL)		
<0.6	3	10.0
0.6 – 1.2	19	63.3
>1.2	8	26.7
Serum albumin (g/dL)		
<3.5	17	56.7
≥3.5	13	43.3

The above table 3 shows that most of the clients with type 2 diabetes mellitus, 16(53.3%) had HbA1c (%) <6, 19(63.3%) had serum creatinine level in the range

of 0.6 – 1.2 mg/dL and 17(56.7%) had serum albumin <3.5 gm/dL.



Percentage distribution of level of hba1c variability and hypoglycemia among clients with type 2 diabetes mellitus

Section C: Relationship Between Hba1c Variability and Hypoglycemia Among Clients with Type 2 Diabetes Mellitus.

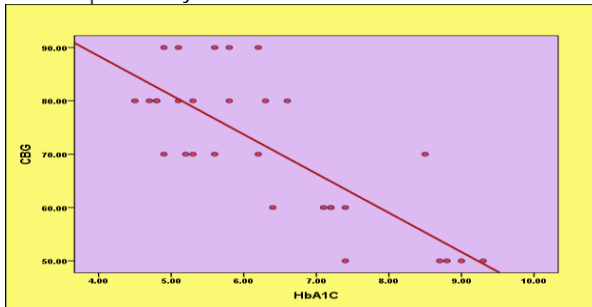
Correlation between HbA1c variability and hypoglycemia among clients with type 2 diabetes mellitus. n = 30

Variables	Mean	S.D	Karl Pearson’s Correlation ‘r’ Value
HbA1c variability	6.32	1.43	r = 0.520 p=0.003, S**
Serum Creatinine	1.0	0.32	
HbA1c variability	6.32	1.43	r = 0.442 p=0.015, S*
Serum Albumin	3.39	0.26	
Serum Creatinine	1.0	0.32	r = 0.489 p=0.006, S**
Serum Albumin	3.39	0.26	
HbA1c variability	6.32	1.43	r = -0.777 p=0.0001, S***
CBG	71.33	13.58	

The above table shows depicts that the mean score

of HbA1c among clients with type 2 diabetes mellitus

was 6.32 ± 1.43 , mean score of serum creatinine was 1.0 ± 0.32 , mean score of serum albumin was 3.39 ± 0.26 and the mean score of CBG was 71.33 ± 13.58 . The calculated Karl Pearson's Correlation value of $r = 0.520$ between HbA1c variability Vs. Serum creatinine, $r = 0.442$ between HbA1c variability Vs. Serum albumin and $r = 0.489$ between Serum creatinine Vs. Serum albumin shows a mild positive correlation which was found to be statistically significant at $p < 0.01$, $p < 0.05$ and $p < 0.01$ level respectively.



Scatter Dot diagram showing the correlation between the HbA1c Variability and CBG among clients with type 2 diabetes mellitus ($r = -0.777$)

Whereas the calculated Karl Pearson's Correlation value of $r = -0.777$ between HbA1c variability Vs. CBG shows a strong negative correlation which clearly infers that when HbA1c variability increases then CBG level decreases which ultimately shows the possibility of patients getting hypoglycemia.

SECTION –D: Association of level of HbA1c variability and hypoglycemia among clients with type 2 diabetes mellitus with their selected demographic variables.

The Demographic variables includes Age, Gender, Religion, Educational status, occupational status, Residence, Marital status, Economic Status, type of family, Dietary Habit. The results shows that none of the demographic variables had shown statistically significant association with level of HbA1c variability, Serum creatinine and Serum albumin level among clients with type 2 diabetes mellitus.

Association of level of HbA1c variability and hypoglycemia among clients with type 2 diabetes mellitus with their selected clinical variables.

The clinical Variable includes Type of diabetes mellitus, History of type 2 diabetes mellitus, family History of type 2 diabetes mellitus, past medical History, Regular clinical visits, Regular medication usage, Diabetes medication usage. The results shows that none of the clinical variables had shown statistically significant association with level of HbA1c variability, Serum creatinine and Serum albumin level among clients with type 2 diabetes Mellitus.

4. Conclusion

The increasing HbA1c levels variability and elevated HbA1c are associated with a greater risk of hypoglycaemia. Severe hypoglycemia resulting in hospitalization leads to poor health outcomes and mortality in older adults with diabetes mellitus. The

increasing HbA1c levels variability and elevated HbA1c are associated with a greater risk of hypoglycaemia. The HbA1c level is a predictor for risk of hypoglycaemia and hypoglycaemia induced Hospitalisation.

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6. Conflicts of interest

The authors declare no conflicts of interest.

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