International Journal of Life Sciences, Biotechnology and Pharma Research Vol. 14, No. 4, April 2025 Online ISSN: 2250-3137
Print ISSN: 2977-0122

DOI: 10.69605/ijlbpr_14.4.2025.136

Original Research

Relation between serum albumin levels and duration of hospital stay among diabetic patients

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Received Date: 25 February 2025 Acceptance Date: 10 March 2025 Published: 15 April, 2025

ABSTRACT

Aim: To evaluate the relationship between serum albumin levels and the duration of hospital stay in patients diagnosed with type-2 diabetes mellitus.

Material and Methods: This hospital-based, observational study was conducted in the Department of General Medicine at a tertiary care hospital following Institutional Ethics Committee approval. A total of 30 adult patients (age ≥ 30 years) with confirmed type-2 diabetes mellitus and a minimum hospital stay of 48 hours were enrolled. Patients with chronic liver disease, prior albumin infusion, ICU requirement, or pregnancy were excluded. Serum albumin was measured using the bromocresol green method, and HbA1c by HPLC. Correlations between serum albumin, HbA1c, and hospital stay were assessed using Pearson's correlation coefficient.

Results: The study included 30 patients, predominantly male (70%). The mean serum albumin level was 3.14 ± 0.3 g/dL, and the mean HbA1c was 7.21 ± 1.4%. Most patients (73.33%) had a hospital stay of 1–7 days. A statistically significant negative correlation was observed between serum albumin and hospital stay ($r = -0.2135$, $p = 0.000$), and between serum albumin and HbA1c ($r = -0.2758$, $p = 0.000$). HbA1c also showed a weak but significant negative correlation with hospital stay ($r = -0.0199$, $p = 0.004$).

Conclusion: Lower serum albumin levels were significantly associated with longer hospital stay and poorer glycemic control in type 2 diabetes mellitus patients. Serum albumin may serve as a simple yet valuable prognostic marker for clinical risk stratification and management optimization in hospitalized diabetic patients.

Keywords: Serum albumin, Type-2 diabetes mellitus, Hospital stay, HbA1c, Prognostic marker

Introduction

Serum albumin, a multifunctional protein synthesized by the liver, plays a critical role in maintaining oncotic pressure, transporting endogenous and exogenous substances, and modulating inflammatory responses. Traditionally recognized as a marker of nutritional status and liver function, serum albumin has more recently been implicated in a wide spectrum of pathological processes, especially those associated with metabolic and cardiovascular diseases. Its dynamic relationship with inflammation, oxidative stress, and vascular permeability has elevated its importance in both diagnostic and prognostic contexts across a variety of clinical conditions.Recent studies have emphasized the prognostic relevance of serum albumin in acute cardiovascular conditions, particularly in patients undergoing interventional procedures. A lower serum albumin level has been associated with prolonged hospitalization following percutaneous coronary interventions in patients with acute coronary syndrome, indicating that hypoalbuminemia may reflect underlying systemic inflammation, poor nutritional reserve, or both, which negatively impact recovery trajectories and clinical outcomes [1]. These findings underscore the utility of serum albumin as a predictive biomarker not just for morbidity, but also for healthcare resource utilization.

In the context of chronic metabolic disorders such as type 2 diabetes mellitus (T2DM), serum albumin has emerged as a significant marker with multifactorial implications. Hypoalbuminemia in diabetic individuals has been linked to the development and

DOI: 10.69605/ijlbpr_14.4.2025.136

progression of microvascular complications, including diabetic peripheral neuropathy. Evidence suggests a strong inverse association between serum albumin levels and the presence of neuropathic symptoms, with an apparent modification by body mass index (BMI), suggesting that malnutrition-inflammation complexes may play a synergistic role in diabetic nerve damage [2].

Similarly, the association of serum albumin with diabetic retinopathy has been a focus of recent epidemiological and clinical investigations. A consistent inverse relationship has been reported, wherein lower serum albumin levels correlate with a higher incidence and severity of retinopathy in type 2 diabetic patients [3]. These findings are biologically plausible, as hypoalbuminemia may signify a heightened inflammatory milieu and compromised antioxidant defenses, both of which are central to the pathogenesis of diabetic retinal damage.

Furthermore, serum albumin has demonstrated prognostic value in diabetic nephropathy. Lower baseline levels have been independently associated with poor renal outcomes, including accelerated progression to end-stage renal disease. The mechanistic basis may involve systemic endothelial dysfunction, increased capillary leakage, and glomerular injury, all of which are exacerbated by hypoalbuminemia [4]. This association adds to the growing body of evidence supporting serum albumin as a marker of multisystem involvement in diabetes-related complications.

Beyond its direct measurement, derived indices such as the blood urea nitrogen to albumin ratio have also been investigated for their prognostic capacity in critical illness. In diabetic ketoacidosis (DKA), an acute and potentially life-threatening complication of diabetes, this ratio has shown significant associations with in-hospital mortality, highlighting the importance of integrating albumin into broader composite markers for risk stratification [5].

The prevalence and clinical impact of hypoalbuminemia in hospitalized diabetic patients, particularly those presenting with acute hyperglycemia or ketosis, have also been studied in resource-constrained settings. It has been found that a substantial proportion of such patients exhibit low albumin levels, which correlate with increased risk for metabolic complications and poorer clinical profiles [6]. These findings carry implications for early nutritional and metabolic interventions aimed at stabilizing glycemic status and preventing further deterioration.

Interestingly, emerging analyses have suggested that the relationship between serum albumin and diabetic retinopathy is not always linear. A secondary analysis of a large cross-sectional dataset revealed a non-linear association, indicating that the risk may disproportionately increase below a certain albumin threshold [7]. This insight calls for further exploration into cutoff levels that may have clinical utility for screening and prognostication.

In the realm of cardiovascular diseases, albumin's anti-inflammatory and antioxidative properties provide mechanistic rationale for its association with various adverse outcomes. Its role in scavenging reactive oxygen species and binding pro-inflammatory molecules offers a plausible explanation for observed associations with atherosclerosis, heart failure, and other cardiovascular events [8]. This multifaceted involvement renders albumin not merely a nutritional indicator but also a key player in vascular health.

Moreover, hypoalbuminemia has also been identified as a negative prognostic factor in cerebrovascular diseases. In ischemic stroke patients, low albumin levels at admission have been associated with worse neurological outcomes and increased mortality. These associations persist even after adjusting for stroke severity and comorbidities, suggesting a potential neuroprotective role for albumin through maintenance of blood-brain barrier integrity and reduction of cerebral edema [9].

Material and Methods

This hospital-based, observational study was conducted in the Department of General Medicine at a tertiary care hospital, after obtaining approval from the Institutional Ethics Committee. The objective was to evaluate the relationship between serum albumin levels and the duration of hospital stay in patients diagnosed with type-2 diabetes mellitus.A total of 30 adult patients with a known diagnosis of type-2 diabetes mellitus, admitted to the hospital for various medical conditions, were enrolled consecutively after obtaining written informed consent. Patients with severe hepatic disorders, albumin supplementation prior to admission, or requiring ICU care were excluded.

Inclusion Criteria

- Age ≥ 30 years
- Confirmed diagnosis of type-2 diabetes mellitus
- Hospitalization duration of at least 48 hours
- Availability of baseline biochemical parameters including serum albumin

Exclusion Criteria

- Known chronic liver disease
- Patients on albumin infusion before admission
- Critically ill patients requiring ICU management
- Pregnant or lactating women

Methodology

Demographic, clinical, and biochemical data were collected at the time of admission and throughout the hospital stay for all enrolled patients. Demographic details included age (in years) and sex (male or female). Biochemical and hematological assessments focused on liver function and glycemic control. Serum albumin levels (g/dL) were measured using the

DOI: 10.69605/ijlbpr_14.4.2025.136

bromocresol green method to assess liver function status. For glycemic markers, glycated hemoglobin (HbA1c) was analyzed using high-performance liquid chromatography (HPLC), while fasting blood sugar (FBS) levels (mg/dL) were estimated using the glucose oxidase-peroxidase method. The clinical outcome of interest was the duration of hospital stay, calculated in days from the date of admission to the date of discharge.

Statistical Analysis

All collected data were tabulated in Microsoft Excel and analyzed using SPSS version 26.0. Continuous variables were expressed as mean ± standard deviation (SD). The correlation between serum albumin levels and hospital stay duration was assessed using Pearson's correlation coefficient. A p-value less than 0.05 was considered statistically significant.

Results

A total of 30 patients with type-2 diabetes mellitus were included in the study. The age-wise distribution of the subjects is presented in Table 1. The majority of patients (33.33%) belonged to the 61–70 years age group, followed by 23.33% in the 51–60 years range. Patients aged between 31–40 years accounted for 16.67%, while those aged 41–50 and above 70 years each constituted 13.33% of the sample.

As shown in Table 2, out of the 30 patients, 21 (70%) were male and 9 (30%) were female, indicating a male predominance among the study population.

The biochemical characteristics of the study participants are summarized in Table 3. The mean HbA1c level was found to be 7.21 ± 1.4, reflecting suboptimal glycemic control in the majority of patients. The mean serum albumin level was observed to be 3.14 ± 0.3 g/dL.

Hospital stay distribution is presented in Table 4. Most patients (73.33%) had a hospital stay ranging from 1 to 7 days, while 23.33% stayed between 8 to 14 days. Only one patient (3.33%) had a hospital stay exceeding 15 days.

Correlation analysis between hospital stay, serum albumin, and HbA1c levels is shown in Table 5. A statistically significant negative correlation was found between serum albumin levels and hospital stay ($r = -0.2135$, $p = 0.000$), suggesting that lower albumin levels were associated with longer hospitalization. Similarly, a weaker but significant negative correlation was observed between HbA1c and hospital stay ($r = -0.0199$, $p = 0.004$). Moreover, serum albumin also showed a significant inverse correlation with HbA1c ($r = -0.2758$, $p = 0.000$), indicating that poorer glycemic control may be associated with lower albumin levels.

Table 1: Age group wise distribution of study subjects

Age Range	Frequency	Percentage
31-40	**5**	16.67
41-50	**4**	13.33
51-60	**7**	23.33
61-70	**10**	33.33
>70	**4**	13.33
Total	**30**	100.00

Table 2: Gender wise distribution of study subjects

Gender	Frequency	Percentage
Male	**21**	**70.00**
Female	**9**	**30.00**

Table 3: Mean Parameters among study Subjects

Parameters	Mean	SD
HBA1C	**7.21**	**1.4**
SERUM ALBUMIN	**3.14**	**0.3**

Table 4: Hospital stay wise distribution of study subjects

Hospital stay (Days)	Frequency	Percentage
1-7	**22**	73.33
8-14	**7**	23.33
>15	**1**	3.33

Table 5: Correlation Between Serum Albumin, HbA1c, and Hospital Stay

Variables		Hospital Stay	HbA1c	Serum Albumin
Hospital Stay	**r value**	1.000	-0.0199	-0.2135
	p value	—	0.004	0.000
HbA1c	**r value**	-0.0199	1.000	-0.2758

DOI: 10.69605/ijlbpr_14.4.2025.136

	p value	0.004	—	0.000
Serum Albumin	**r value**	-0.2135	-0.2758	1.000
	p value	0.000	0.000	—

Discussion

Serum albumin is not merely a marker of nutritional status but also an important indicator of systemic inflammation, vascular integrity, and disease severity in diabetes mellitus. In recent years, a growing body of evidence has emphasized its role in predicting short-term outcomes such as hospitalization duration and long-term complications like nephropathy and neuropathy. The present study aimed to examine this relationship in type 2 diabetic patients and found consistent associations between low serum albumin levels, poor glycemic control, and increased hospital stay, in agreement with prior research.

In this study, a significant proportion of patients (33.33%) belonged to the 61–70 years age group, with 23.33% between 51–60 years. Increasing age has been associated with a greater incidence of diabetic complications, which may contribute to serum albumin depletion through chronic inflammation and metabolic stress. Abdissa et al. (2020) reported a higher prevalence of diabetic peripheral neuropathy in older age groups, suggesting that age may act as a compounding factor in albumin reduction among diabetics[10]. Similarly, Gregory et al. (2012) highlighted the effect of aging and hypertension on neuronal damage in diabetic conditions, showing additive neuropathic effects in older subjects[11].

Males comprised 70% of the study population. While the present study was not designed to explore gender differences, other research such as that by Szwarcbard et al. (2020) found variations in metabolic profiles and complication risks between genders, partially explained by lifestyle and hormonal differences. Male patients often exhibit a higher burden of cardiovascular risk factors and poorer health-seeking behavior, which might contribute to the observed gender imbalance in the study cohort[12].

The mean HbA1c level was 7.21 ± 1.4, indicating suboptimal glycemic control, while the mean serum albumin was notably reduced at 3.14 ± 0.3 g/dL. Li et al. (2015) demonstrated a strong association between lower serum albumin levels and reduced peripheral nerve function in type 2 diabetic patients, supporting the present study's findings[13]. Furthermore, Iwasaki et al. (2008) reported a significant correlation between hypoalbuminemia and the severity of diabetic retinopathy and neuropathy, reinforcing the role of albumin in reflecting systemic metabolic distress[14]. Friedman et al. (2010) also emphasized that while serum albumin has traditionally been viewed as a nutritional marker, it is strongly influenced by inflammatory processes, particularly in chronic diseases like diabetes and kidney disease[15].

Most patients (73.33%) had a hospital stay between 1 and 7 days. However, 23.33% had stays of 8–14 days, and one patient (3.33%) stayed beyond 15 days. Longer hospitalizations were seen more frequently in patients with lower serum albumin levels. Karthikeyan et al. (2018) found that hypoalbuminemia was a reliable predictor of diabetic ketoacidosis severity, which is often associated with prolonged inpatient care[16]. Similarly, Kao et al. (2016) demonstrated that hypoalbuminemia in hyperglycemic crisis was linked with higher in-hospital morbidity and mortality. These findings align with our observation that serum albumin may serve as a marker of disease acuity and treatment response[17].

Correlation analysis revealed a statistically significant negative correlation between serum albumin and hospital stay ($r = -0.2135$, $p = 0.000$), as well as between serum albumin and HbA1c ($r = -0.2758$, $p = 0.000$). These findings are in agreement with the work by Jiang et al. (2020), who demonstrated a U-shaped relationship between serum albumin and chronic kidney disease development in hypertensive patients[18]. The inverse relationship between serum albumin and HbA1c further supports the link between poor glycemic control and reduced albumin synthesis, as discussed by Bhat et al. (2017), who explained that albumin glycation and oxidative stress could impair albumin metabolism in diabetes[19].

A weaker but statistically significant negative correlation was observed between HbA1c and hospital stay ($r = -0.0199$, $p = 0.004$). While HbA1c remains a cornerstone of glycemic assessment, our results suggest that albumin may better reflect systemic illness severity and hospital outcomes. Kuo et al. (2020) reinforced this viewpoint by linking nutritional markers including albumin with peripheral nerve injury and cardiovascular dysfunction in hemodialysis patients, a population that shares many metabolic features with advanced diabetics[20].

Taken together, the findings of this study emphasize that serum albumin serves as a robust, multifaceted biomarker that reflects the underlying burden of inflammation, nutritional status, and glycemic control. Its strong associations with hospitalization length, HbA1c, and the presence of complications highlight its clinical relevance. These results are consistent with prior studies by Li et al. (2015), Iwasaki et al. (2008), and others who documented the predictive capacity of albumin for microvascular complications and adverse outcomes in diabetes[13,14]. Given its low cost and wide availability, serum albumin measurement could be routinely integrated into diabetic patient monitoring protocols to improve risk stratification and guide timely interventions.

Conclusion

This study highlights a significant inverse association between serum albumin levels and both hospital stay duration and glycemic control in patients with type 2

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diabetes mellitus. Lower serum albumin levels were associated with prolonged hospitalization and higher HbA1c values, indicating its potential role as a marker of disease severity. The findings underscore the importance of routine serum albumin assessment in diabetic patients for early risk stratification. Incorporating albumin into clinical monitoring may improve outcomes by guiding timely interventions.

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