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ASSOCIATION BETWEEN SERUM ALBUMIN LEVELS AND IN-HOSPITAL OUTCOMES IN PATIENTS WITH ACUTE MEDICAL ILLNESSES

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Abstract

Background: *Serum albumin is an important biochemical marker reflecting nutritional status, systemic inflammation and disease severity. Hypoalbuminemia is frequently observed in patients with acute medical illnesses and has been associated with adverse clinical outcomes, including mortality and prolonged hospitalization.*

Objectives: *To determine the association between serum albumin levels and in-hospital outcomes in patients with acute medical illnesses.*

Study Design & Setting: *Cross-sectional study conducted at the Department of Medicine, Mohtarma Benazir Bhutto Shaheed Medical College (MBBSMC).*

Methodology: *A total of 120 patients aged 18 years and above with acute medical illnesses were enrolled. Serum albumin levels were measured at admission and patients were categorized into hypoalbuminemia (<3.5 g/dL) and normal albumin (≥3.5 g/dL) groups. Patients were followed throughout hospitalization, and mortality, in-hospital complications, ICU admission and duration of hospital stay were recorded. Data were analyzed using SPSS version 26.0.*

Results: *The mean age of patients was 52.4 ± 16.2 years, and 56.7% were males. Hypoalbuminemia was observed in 54 (45.0%) patients, while 66 (55.0%) had normal albumin levels. In-hospital mortality was higher among patients with hypoalbuminemia than those with normal albumin levels (24.1% vs. 7.6%). Similarly, complications (42.6% vs. 19.7%) and ICU admissions (31.5% vs. 10.6%) were more frequent in the*

hypoalbuminemia group. Mean hospital stay was 8.2 ± 3.5 days in patients with hypoalbuminemia compared with 5.7 ± 2.4 days in patients with normal albumin levels.

Conclusion: *Hypoalbuminemia was associated with higher frequencies of adverse in-hospital outcomes, including mortality, complications and ICU admission, as well as longer hospitalization. Serum albumin may serve as a useful prognostic marker in patients with acute medical illnesses.*

INTRODUCTION

Serum albumin is the most abundant protein in human plasma and is synthesized predominantly by hepatocytes. It plays an essential role in maintaining colloid osmotic pressure, regulating intravascular fluid distribution, transporting hormones, fatty acids and medications, and providing antioxidant protection.[1,2] Normal serum albumin concentrations generally range from 3.5 to 5.0 g/dL, whereas concentrations below 3.5 g/dL are commonly classified as hypoalbuminemia.[3] Reduced serum albumin is frequently encountered in patients presenting with acute medical illnesses, including infections, cardiovascular disorders, renal dysfunction, hepatic diseases and gastrointestinal conditions. Its concentration reflects several physiological and pathological processes rather than nutritional status alone.[4,5]

The etiology of hypoalbuminemia is multifactorial and varies according to the underlying illness. Reduced hepatic synthesis may occur in chronic liver disease and severe hepatic dysfunction, while increased urinary protein loss is characteristic of nephrotic syndrome.[6] Gastrointestinal protein loss, inadequate dietary protein intake, malabsorption, extensive burns and major fluid shifts may also contribute. During acute illnesses, systemic inflammation and sepsis are particularly important causes because they alter albumin distribution, metabolism and vascular permeability.[7]

Hypoalbuminemia represents a substantial clinical burden among hospitalized populations worldwide. A large retrospective cohort involving 156,511 hospitalized patients aged over 40 years reported that 21% had serum albumin concentrations below 3.5 g/dL. In this population, in-hospital mortality was 14% among patients with hypoalbuminemia compared with 4% among those with normal albumin concentrations, demonstrating a considerable difference in clinical outcomes.[8]

The pathophysiology of reduced albumin during acute illness involves complex inflammatory and metabolic mechanisms. Inflammatory cytokines increase endothelial permeability, promoting movement of albumin from the intravascular compartment into the interstitial space.[9] Simultaneously, accelerated albumin catabolism, redistribution, increased protein losses and alterations in hepatic protein synthesis contribute to declining circulating concentrations. As albumin maintains plasma oncotic pressure, its reduction encourages fluid extravasation and tissue edema. These changes may compromise tissue perfusion, organ function and physiological recovery. [10]

In-hospital outcomes constitute an important measure of disease severity and clinical prognosis among patients admitted with acute medical conditions. These outcomes commonly include mortality during hospitalization, development of complications, requirement for intensive care admission and duration of hospital stay.[11]

Serum albumin is routinely assessed through biochemical analysis of a venous blood sample, generally using automated colorimetric methods such as bromocresol green or bromocresol purple dye-binding assays. The measured concentration provides an objective laboratory parameter that can be interpreted alongside the patient's clinical condition, inflammatory status, liver and renal function, and other biochemical findings. Serial measurements may also demonstrate changes in albumin concentration during hospitalization

and provide additional information about the patient's evolving clinical condition.[12]

Serum albumin is an important biochemical marker that reflects systemic inflammation, nutritional status, hepatic function and disease severity in patients with acute medical illnesses.[13]

Pakistani studies have mainly focused on specific conditions, such as pneumonia and critically ill ICU patients, rather than heterogeneous acute medical admissions. Moreover, local studies have reported different frequencies and outcome patterns, reflecting variations in patient populations and clinical settings. The present study will provide local evidence regarding the relationship between serum albumin levels and in-hospital mortality, complications and duration of hospitalization. Its findings will add to existing literature by evaluating albumin as a prognostic marker across a broader population of patients with acute medical illnesses in Pakistan.

METHODS

A cross-sectional study was conducted on 120 patients presenting with acute medical illnesses at the Department of Medicine, Mohtarma Benazir Bhutto Shaheed Medical College (MBBSMC). From January 2026 to June 2026. Patients of either gender, aged 18 years and above, who required hospital admission for acute medical conditions were included in the study. Patients with known chronic liver disease, nephrotic syndrome, malignancy, pregnancy, or those receiving albumin infusion before sample collection were excluded to minimize conditions that could independently influence serum albumin concentrations.

The sample size of 120 patients was calculated using the WHO sample size formula for a single population proportion, taking an anticipated prevalence of hypoalbuminemia of 21%, a 95% confidence level and an absolute precision of 7.3%.

After obtaining written informed consent, demographic and clinical information, including age, gender, presenting complaints, underlying medical condition, comorbidities and relevant clinical findings, was recorded. A venous blood sample was collected from each patient at the time of admission under aseptic conditions. Serum albumin concentration was measured using an automated biochemical analyzer. Hypoalbuminemia was defined as serum albumin concentration below 3.5 g/dL, whereas concentrations of 3.5 g/dL or above were considered normal. Patients were categorized into two groups according to their serum albumin levels.

All patients were followed throughout their hospital stay, and in-hospital outcomes were documented. These included mortality, development of in-hospital complications, requirement for intensive care unit admission and duration of hospital stay in days. The collected information was recorded on a structured proforma.

Data were analyzed using SPSS version 26.0. Quantitative variables, including age, serum albumin concentration and duration of hospital stay, were expressed as mean ± standard deviation. Qualitative variables, including gender, hypoalbuminemia, in-hospital mortality, complications and ICU admission, were presented as frequency and percentages. The association between serum albumin categories and categorical in-hospital outcomes was assessed using the chi-square test. An independent-sample t-test was used to compare mean hospital stay between the two albumin groups. A p-value of ≤0.05 was considered statistically significant.

RESULTS

Table 1 showed that the mean age of the patients was 52.4 ± 16.2 years. Most patients (40.0%) belonged to the 41–60 years age group, followed by 33.3% aged above 60 years and 26.7% aged 18–40 years. Males constituted 56.7% of the study population, while females accounted for 43.3%, as shown in Table 1.

Table 2 showed that hypertension was the most common comorbidity, observed in 37.5% of patients, followed by diabetes mellitus (31.7%), ischemic heart disease (20.0%) and chronic kidney disease (10.0%). Regarding acute medical illnesses, infectious diseases accounted for 35.0%, followed by respiratory illnesses (30.0%), cardiovascular illnesses (20.8%) and other medical illnesses (14.2%), as given in Table 2.

Table 3 showed that hypoalbuminemia (serum albumin below 3.5 g/dL) was present in 54 (45.0%) patients, whereas 66 (55.0%) patients had normal serum albumin levels. The overall mean serum albumin concentration was 3.42 ± 0.78 g/dL, as shown in Table 3.

Table 4 showed that in-hospital mortality occurred in 18 (15.0%) patients, while 36 (30.0%) patients developed in-hospital complications. ICU admission was required in 24 (20.0%) patients, and 42 (35.0%) patients experienced a prolonged hospital stay of more than seven days. The mean duration of hospitalization was 6.8 ± 3.2 days, as given in Table 4.

Table 5 showed that mortality was higher among patients with hypoalbuminemia (24.1%) compared with those having normal albumin levels (7.6%). Similarly, in-hospital complications were observed in 42.6% of patients with hypoalbuminemia compared with 19.7% of patients with normal albumin levels. ICU admission was also more frequent among patients with hypoalbuminemia (31.5%) than those with normal albumin levels (10.6%). Furthermore, the mean hospital stay was longer in patients with hypoalbuminemia (8.2 ± 3.5 days) compared with patients having normal albumin levels (5.7 ± 2.4 days), as shown in Table 5.

International Journal of Advanced Research

Table 1. Demographic characteristics of patients (n=120)

Variables	Frequency (%) / Mean ± SD
Age (years)	52.4 ± 16.2
18–40 years	32 (26.7%)
41–60 years	48 (40.0%)
>60 years	40 (33.3%)
Male	68 (56.7%)
Female	52 (43.3%)

Table 2. Clinical characteristics of patients (n=120)

Variables	Frequency (%)
Hypertension	45 (37.5%)
Diabetes mellitus	38 (31.7%)
Ischemic heart disease	24 (20.0%)
Chronic kidney disease	12 (10.0%)
Respiratory illnesses	36 (30.0%)
Infectious illnesses	42 (35.0%)
Cardiovascular illnesses	25 (20.8%)
Other acute medical illnesses	17 (14.2%)

Table 3. Distribution of patients according to serum albumin levels (n=120)

Serum albumin status	Frequency (%)
Hypoalbuminemia (7 days)	42 (35.0%)
Mean hospital stay (days)	6.8 ± 3.2

Table 5. Association between serum albumin levels and in-hospital outcomes (n=120)

In-hospital outcomes	Hypoalbuminemia (n=54)	Normal albumin (n=66)	Total
Mortality			
Yes	13 (24.1%)	5 (7.6%)	18 (15.0%)
No	41 (75.9%)	61 (92.4%)	102 (85.0%)
In-hospital complications			
Yes	23 (42.6%)	13 (19.7%)	36 (30.0%)
No	31 (57.4%)	53 (80.3%)	84 (70.0%)
ICU admission			
Yes	17 (31.5%)	7 (10.6%)	24 (20.0%)
No	37 (68.5%)	59 (89.4%)	96 (80.0%)
Hospital stay (days)	8.2 ± 3.5	5.7 ± 2.4	6.8 ± 3.2

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DISCUSSION

Serum albumin is the most abundant plasma protein and plays an essential role in maintaining oncotic pressure, transporting various substances and regulating fluid distribution. Hypoalbuminemia, commonly defined as serum albumin below 3.5 g/dL, is frequently observed in patients with acute medical illnesses. Acute illnesses such as infections, cardiovascular disorders and respiratory diseases may contribute to reduced serum albumin concentrations. Low serum albumin has been associated with increased mortality, complications, intensive care requirements and prolonged hospital stay.[14]

These findings were consistent with Jellinge et al. (2014), who reported significantly higher 30-day mortality among patients with hypoalbuminemia compared with those having normal albumin levels (16.3% vs. 4.3%, p<0.0001). They also demonstrated an independent association between hypoalbuminemia and mortality (OR 1.95, 95% CI 1.31–2.90). Although mortality was higher in the hypoalbuminemia groups of both studies, the absolute mortality frequencies were greater in the present study. This difference might be explained by variations in patient characteristics, severity of acute illness and duration of outcome assessment. Furthermore, the longer hospital stay observed among patients with hypoalbuminemia in the present study (8.2 ± 3.5 vs. 5.7 ± 2.4 days) was consistent with their findings regarding prolonged hospitalization.[13] Similarly, Thongprayoon et al. (2020) reported a progressive increase in short-term and long-term mortality with decreasing admission serum albumin concentrations. Patients with albumin levels below 4.0 g/dL had higher mortality risks than those with concentrations of 4.0–4.4 g/dL. This finding supported the present observation that mortality was more frequent among patients with hypoalbuminemia. However, their evaluation of multiple albumin categories provided a more detailed assessment of the relationship between albumin concentration and mortality, whereas the present study classified patients using a threshold of 3.5 g/dL.[14]

Viasus et al. (2013) demonstrated that lower serum albumin concentrations were significantly associated with increased mortality, ICU admission, complications and prolonged

hospitalization among patients with community-acquired pneumonia. Similar patterns were observed in the present study, where in-hospital complications occurred in 42.6% of patients with hypoalbuminemia compared with 19.7% of those with normal albumin levels. ICU admission was also more frequent in the hypoalbuminemia group (31.5% vs. 10.6%), while mean hospital stay was longer (8.2 ± 3.5 vs. 5.7 ± 2.4 days). These similarities suggested that reduced albumin concentrations were associated with several adverse clinical outcomes rather than mortality alone. Nevertheless, the previous study included patients with a specific respiratory infection, whereas the present study involved heterogeneous acute medical conditions, potentially explaining differences in the magnitude of observed outcomes.[15] Adnan et al. (2018) reported comparable findings in a Pakistani study involving 134 patients with community-acquired pneumonia, where hypoalbuminemia was significantly associated with ICU admission (OR 7.956, p=0.001). Longer hospitalization was also observed among patients requiring intensive care (p=0.002). These findings were consistent with the present study, in which ICU admission was approximately three times as frequent among patients with hypoalbuminemia (31.5%) compared with those having normal albumin concentrations (10.6%). However, their reported odds ratio could not be directly compared with this frequency ratio because the two measures represented different statistical quantities. The agreement between these studies indicated a consistent relationship between reduced albumin levels and greater requirements for intensive medical care, although differences in disease severity and patient selection remained important considerations.[16]

Zhao et al. (2021) reported an overall 30-day mortality of 5.46% among 366 patients with community-acquired pneumonia, with lower serum albumin concentrations, particularly levels of 30 g/L or below, associated with increased mortality risk. Their findings were consistent with the present observation that patients with hypoalbuminemia experienced higher in-hospital mortality (24.1%) than those with normal albumin concentrations (7.6%). However, the overall mortality in the present study was 15.0%, which exceeded the 5.46% reported in their study. Differences in underlying illnesses, comorbidities, disease severity and outcome assessment periods might account for this variation. Furthermore, their use of an albumin threshold of 30 g/L differed from the 35 g/L threshold applied in the present study, limiting direct comparison of the albumin groups.[17] In contrast, Adnan et al. (2022) reported an in-hospital mortality frequency of 9.7% among patients with community-acquired pneumonia, but serum albumin demonstrated poor discrimination for mortality, with an AUC of 0.424. Although the present study showed a higher mortality frequency among patients with hypoalbuminemia, these findings were not necessarily contradictory because an association between albumin categories and mortality does not establish accurate prediction of individual outcomes. The previous study assessed discriminatory performance, whereas the present study primarily compared outcome frequencies between albumin groups. Differences in patient characteristics, underlying diseases and accompanying prognostic factors might also explain the variation. These contrasting findings suggested that serum albumin should be interpreted alongside other clinical and biochemical indicators rather than as an isolated predictor of mortality.

Lee et al. (2011) reported an overall 28-day mortality of 13.7% among 424 hospitalized patients with community-acquired pneumonia. Higher serum albumin concentrations of at least 3.3 g/dL were associated with a lower mortality risk (HR 0.5, 95% CI 0.3–0.9). This observation supported the present findings, where mortality was substantially lower among patients with normal albumin concentrations (7.6%) compared with those having hypoalbuminemia (24.1%). The overall mortality frequencies were relatively close, at 13.7% and 15.0%, respectively, although

the previous study assessed 28-day mortality rather than mortality restricted to hospitalization. Their findings also indicated that albumin concentrations might contribute prognostic information when considered alongside established clinical severity measures. Nevertheless, the difference in albumin thresholds between the studies (3.3 vs. 3.5 g/dL) should be considered when interpreting the observed associations.[18] Finally, Yang et al. (2024) investigated serum albumin concentrations in relation to mortality and duration of hospitalization among patients with malignant diseases, with hospital stay as the primary outcome and in-hospital mortality as a secondary outcome. These outcomes were also examined in the present study, where patients with hypoalbuminemia experienced a longer mean hospital stay (8.2 ± 3.5 days) than those with normal albumin levels (5.7 ± 2.4 days), representing a difference of 2.5 days. However, without the corresponding numerical estimates from their study, the magnitude and direction of the associations could not be directly compared. Moreover, patients with malignancies might experience reduced albumin concentrations through mechanisms such as chronic inflammation, malnutrition and altered protein metabolism, which differed from the mechanisms contributing to hypoalbuminemia during acute medical illnesses.[19]

Overall, the present study showed that hypoalbuminemia was associated with unfavorable in-hospital outcomes, including mortality (24.1% vs. 7.6%), complications (42.6% vs. 19.7%), ICU admission (31.5% vs. 10.6%) and longer hospitalization (8.2 ± 3.5 vs. 5.7 ± 2.4 days). These patterns were broadly consistent with previous studies involving acute medical admissions and specific disease populations. However, the variation in reported mortality frequencies, albumin thresholds and prognostic performance indicated that the relationship between serum albumin and clinical outcomes was influenced by underlying disease characteristics and illness severity. Since albumin concentrations are affected by systemic inflammation, hepatic synthesis, nutritional status, renal protein loss and vascular permeability, reduced levels may represent a marker of physiological disturbance rather than an independent cause of adverse outcomes. Furthermore, the absence of adjusted analyses in the present study limited conclusions regarding the independent prognostic contribution of hypoalbuminemia.

STUDY LIMITATIONS

This study was conducted at a single center with a relatively small sample size of 120 patients, which may limit the generalizability of findings. The cross-sectional design limited the assessment of temporal changes in serum albumin levels during hospitalization. Variations in the severity and types of acute medical illnesses may have influenced serum albumin concentrations and clinical outcomes. Potential confounding factors, including nutritional status, inflammatory markers and underlying comorbidities, may not have been fully controlled.

CONCLUSION

Hypoalbuminemia was observed in 45% of patients admitted with acute medical illnesses. Patients with hypoalbuminemia had higher frequencies of in-hospital mortality, complications and ICU admission, along with longer hospital stays. Serum albumin levels may serve as a useful prognostic indicator for identifying patients at increased risk of adverse in-hospital outcomes.

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