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# Impact of Post–Cardiac Valve Replacement Surgery Nutrition on Recovery, Inflammation, And Quality of Life Among Cardiac Patients

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## ABSTRACT

Background: After cardiac valve replacement surgery, there is a pronounced inflammatory response and heightened metabolic rate. The adequacy of nutrition may affect immune modulation, recovery parameters, and quality of life (QOL), but there is a paucity of combined prospective data.

Objective: To assess the effect of postoperative nutritional status on inflammation, recovery, and QOL in patients undergoing cardiac valve replacement surgery.

Materials and Methods: A prospective observational study was performed from January 2026 to March 2026 in a tertiary care cardiothoracic surgery unit. A total of 250 adult patients (18-80 years) undergoing elective aortic, mitral, or double valve replacement surgery were studied. Postoperative nutritional status was determined by dietary and biochemical parameters (calorie and protein intake, serum albumin, prealbumin, hemoglobin, vitamin D, and omega-3 fatty acid intake), and patients were classified as having adequate, moderate, or poor nutrition. Inflammatory response was measured by CRP levels (Day 1, Day 3, and Day 7). Recovery parameters included wound healing score, ejection fraction (EF), and ambulation time. QOL was measured by SF-36/WHOQOL-BREF questionnaires at baseline (discharge), 1 month, and 3 months. Statistical analysis included descriptive and comparative statistics using independent t-test/ANOVA, with $p<0.05$ considered significant.

Results: Mean age was 56.27 ± 12.74 years, with 133 (53.2%) male and 117 (46.8%) female patients. CRP values reduced in all nutritional groups from Day 1 to Day 7. In the adequate nutrition group, mean CRP reduced from 30.43 ± 12.51 (Day 1) to 21.03 ± 11.96 (Day 7). Comparison between adequate and poor nutrition groups revealed no statistically significant difference in CRP values on Day 1 ($p=0.973$), Day 3 ($p=0.975$), and Day 7 ($p=0.937$). Recovery rates were in favor of the adequate nutrition group, with higher wound healing score (7.50 ± 1.70 vs 7.02 ± 1.64, $p=0.155$), slightly higher EF (55.12 ± 5.83 vs 53.90 ± 5.76, $p=0.329$), and earlier ambulation (3.82 ± 1.42 vs 4.24 ± 1.51 days, $p=0.228$) compared with the poor nutrition group. QOL scores improved progressively in all groups; at 3 months, QOL scores were higher in the adequate nutrition group (73.33 ± 5.11) compared with the poor nutrition group (71.57 ± 5.66), with a near-significant trend ($p=0.095$).

Conclusion: Nutritional adequacy postoperatively showed consistent favorable trends towards recovery and 3-month QOL post cardiac valve replacement surgery, while the lack of statistically significant difference in early postoperative CRP levels between adequate and poor nutrition groups was noted.

***Keywords:*** *Cardiac valve replacement; Postoperative nutrition; Inflammation; C-reactive protein; Recovery outcomes; Wound healing; Quality of life; SF-36; Cardiopulmonary bypass; Nutritional status.*

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## 1. INTRODUCTION

Cardiovascular diseases (CVDs) remain the primary cause of death globally, accounting for 20.5 million deaths per year, with valvular heart disease being a significant contributor to global cardiac morbidity and surgery [1]. Rheumatic heart disease remains a major contributing factor in developing countries, whereas degenerative and calcific valve diseases are more common in developed countries [2]. Valve replacement surgery, whether aortic, mitral, or double valve replacement, is the definitive treatment for severe valvular disease and has been shown to significantly improve survival and functional status [3]. However, postoperative recovery is affected by a variety of physiological and metabolic factors, with nutritional factors playing a critical but often underestimated role [4].

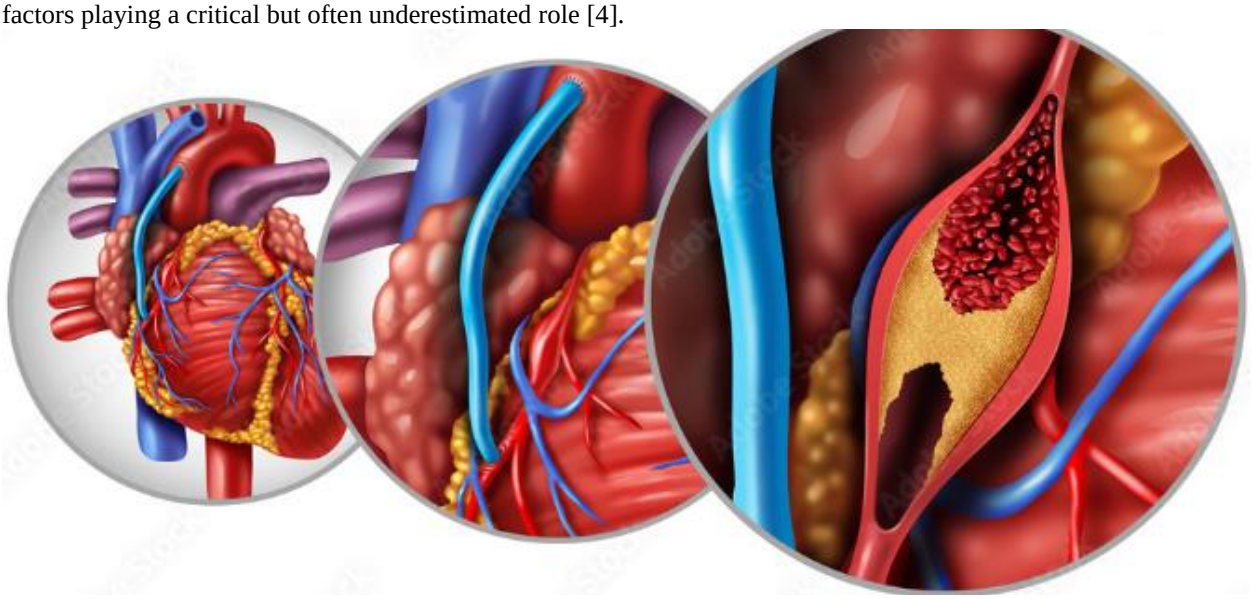

**Figure:1 Bypass surgery and Coronary Artery Grafting**

Major cardiac surgery triggers a severe systemic inflammatory response due to cardiopulmonary bypass, surgical trauma, ischemia-reperfusion injury, and oxidative stress [5]. The inflammatory cascade is characterized by high levels of C-reactive protein (CRP), interleukin-6 (IL-6), tumor necrosis factor-alpha (TNF-α), and other pro-inflammatory cytokines, which have been implicated in the pathogenesis of delayed wound healing, infection, prolonged intensive care unit stay, and poor functional recovery [6,7]. Perioperative nutritional support has been demonstrated to modulate immune function, suppress systemic inflammation, and improve tissue repair mechanisms [8].

Malnutrition is a common finding among hospitalized cardiac patients, with reported prevalence rates ranging from 20% to 50% depending on the criteria used [9]. Hypoalbuminemia, low protein intake, and micronutrient deficiencies have been identified as independent predictors of increased postoperative complications, prolonged hospital stay, and mortality following cardiac surgery [10,11]. Protein-energy malnutrition interferes with collagen synthesis, immune function, and myocardial and surgical wound healing [12]. In addition, deficiencies of micronutrients such as vitamin D, omega-3 fatty acids, zinc, and selenium may contribute to the severity of oxidative stress and inflammation [13,14].

Recent studies have shown that optimized nutrition in the postoperative period can lead to an improvement in recovery parameters, such as early ambulation, enhanced ejection fraction, decreased infection rates, and reduced hospital stay times [15]. Nutritional sufficiency can also help in reducing the inflammatory markers, thus leading to a decrease in postoperative morbidity [16]. Despite these observations, organized nutritional assessment and monitoring are still not uniformly incorporated into the postoperative management of cardiac patients [17].

Apart from the physiological recovery, the importance of quality of life (QOL) has emerged as a major end-point in cardiac surgery studies. Valve replacement surgery does improve functional status and symptoms; however, postoperative fatigue, psychological distress, and social impairment can persist in some patients [18]. Nutritional status has been shown to be associated not only with physical recovery but also with psychological status and overall QOL outcomes [19]. Patients with optimized nutritional intake have been shown to have improved energy levels, enhanced rehabilitation participation,

and improved physical and mental health status as measured by standardized tools such as SF-36 and WHOQOL-BREF [20].

Despite the fact that there are a number of studies that have investigated postoperative inflammation, nutritional status, and quality of life in cardiac surgery patients independently, there is a lack of prospective data that has explored the interrelationship between post-valve replacement surgery nutrition, inflammatory markers, recovery parameters, and quality of life outcomes.

Accordingly, the aim of the current prospective observational study is to assess the effect of post-cardiac valve replacement surgery nutrition on recovery outcomes, inflammatory indices, and quality of life in cardiac patients. By investigating the relationship between nutritional adequacy and the inflammatory response and recovery process, the study aims to provide evidence for the inclusion of structured nutritional care in postoperative cardiac rehabilitation programs.

## 2. MATERIALS AND METHODS

This prospective observational study was carried out in the Department of Cardiothoracic Surgery at a tertiary care hospital from January 2026 to March 2026, with a follow-up period of up to three months postoperatively. A total of 250 adult patients aged 18-80 years undergoing elective aortic, mitral, or double valve replacement surgery were included. Patients undergoing emergency surgery, with severe organ failure, chronic inflammatory conditions, malignancy, or unwilling to participate were excluded. Written informed consent was taken from all participants.

Preoperative demographic and clinical data were recorded. Postoperative nutritional status was evaluated during hospital stay by food diaries and biochemical parameters such as caloric intake, protein intake, serum albumin, prealbumin, hemoglobin, vitamin D, and omega-3 intake. Patients were classified as having adequate, moderate, or poor nutritional status according to recommended intake levels.

Inflammatory markers such as C-reactive protein (CRP), interleukin-6 (IL-6), tumor necrosis factor-alpha (TNF-α), erythrocyte sedimentation rate (ESR), and total leukocyte count were estimated on postoperative Day 1, Day 3, and Day 7. Recovery parameters such as ICU stay, hospital stay, wound healing, infection, ejection fraction, NYHA class, and time to ambulation were recorded.

Quality of life was measured using a validated questionnaire (SF-36/WHOQOL-BREF) at discharge, one month, and three months postoperatively.

Data analysis was done using SPSS software. Continuous variables were presented as mean ± standard deviation, and categorical variables as frequency and percentage. Independent t-test, ANOVA, Pearson correlation, and multiple regression analysis were used. A p-value <0.05 was considered statistically significant. Ethical clearance was taken from the Institutional Ethics Committee, and confidentiality was maintained throughout the study.

## 3. RESULTS

A total of 250 patients who underwent cardiac valve replacement surgery were included in the present study. The mean age of the study population was 56.27 ± 12.74 years, with patients ranging between 35 and 80 years of age. Among the participants, 133 (53.2%) were male and 117 (46.8%) were female, indicating a slight male predominance.

Based on postoperative nutritional assessment, patients were categorized into adequate, moderate, and poor nutrition groups. Inflammatory markers showed a declining trend from postoperative Day 1 to Day 7 across all nutritional categories. The mean Day 1 CRP levels were comparable among the groups, while by Day 7, patients with moderate nutrition demonstrated slightly lower CRP levels compared to adequate and poor nutrition groups.

**Table 1: Inflammatory Markers (CRP) According to Nutritional Category**

| Day | Nutrition Category | n | Mean | SD | SE | t-value* | p-value* |
|---|---|---|---|---|---|---|---|
| **Day 1** | Adequate | 67 | 30.43 | 12.51 | 1.53 | -0.034 | 0.973 |
| | Moderate | 141 | 28.41 | 11.57 | 0.97 | | |
| | Poor | 42 | 30.51 | 11.74 | 1.81 | | |
| **Day 3** | Adequate | 67 | 24.09 | 12.03 | 1.47 | -0.031 | 0.975 |
| | Moderate | 141 | 22.41 | 11.82 | 1.00 | | |
| | Poor | 42 | 24.16 | 11.31 | 1.74 | | |
| **Day 7** | Adequate | 67 | 21.03 | 11.96 | 1.46 | -0.080 | 0.937 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| | Moderate | 141 | 19.46 | 11.74 | 0.99 | | |
| | Poor | 42 | 21.22 | 11.12 | 1.72 | | |

CRP levels showed a gradual decline from Day 1 to Day 7 across all nutritional categories, indicating reduction in postoperative inflammation over time. Although patients with moderate nutrition demonstrated slightly lower CRP values, independent t-test comparison between adequate and poor nutrition groups did not show statistically significant differences at Day 1 (p=0.973), Day 3 (p=0.975), or Day 7 (p=0.937).

**Table 2: Recovery Parameters According to Nutritional Category**

| Parameter | Nutrition Category | n | Mean | SD | SE | t-value* | p-value* |
|---|---|---|---|---|---|---|---|
| Wound Healing Score | Adequate | 67 | 7.50 | 1.70 | 0.21 | 1.43 | 0.155 |
| | Moderate | 141 | 7.42 | 1.62 | 0.14 | | |
| | Poor | 42 | 7.02 | 1.64 | 0.25 | | |
| Ejection Fraction (%) | Adequate | 67 | 55.12 | 5.83 | 0.71 | 0.98 | 0.329 |
| | Moderate | 141 | 54.74 | 6.12 | 0.51 | | |
| | Poor | 42 | 53.90 | 5.76 | 0.89 | | |
| Time to Ambulation (Days) | Adequate | 67 | 3.82 | 1.42 | 0.17 | -1.21 | 0.228 |
| | Moderate | 141 | 4.01 | 1.38 | 0.12 | | |
| | Poor | 42 | 4.24 | 1.51 | 0.23 | | |

Patients with adequate nutrition demonstrated slightly better wound healing scores, higher ejection fraction, and earlier ambulation compared to poor nutrition group. However, differences between adequate and poor nutrition groups were not statistically significant ($p > 0.05$).

**Table 3: Quality of Life According to Nutritional Category**

| Time Point | Nutrition Category | n | Mean | SD | SE | t-value* | p-value* |
|---|---|---|---|---|---|---|---|
| **Baseline** | Adequate | 67 | 55.90 | 4.63 | 0.57 | 1.57 | 0.118 |
| | Moderate | 141 | 54.50 | 4.94 | 0.42 | | |
| | Poor | 42 | 54.48 | 4.54 | 0.70 | | |
| **1 Month** | Adequate | 67 | 65.76 | 5.07 | 0.62 | 1.46 | 0.147 |
| | Moderate | 141 | 64.99 | 5.82 | 0.49 | | |
| | Poor | 42 | 64.21 | 5.87 | 0.91 | | |
| **3 Months** | Adequate | 67 | 73.33 | 5.11 | 0.62 | 1.68 | 0.095 |
| | Moderate | 141 | 72.76 | 5.82 | 0.49 | | |
| | Poor | 42 | 71.57 | 5.66 | 0.87 | | |

Quality of life improved progressively from baseline to 3 months postoperatively across all nutritional groups. Patients with adequate nutrition demonstrated consistently higher QOL scores at baseline, 1 month, and 3 months compared to poor nutrition group. However, independent t-test analysis did not show statistically significant differences between adequate and poor nutrition groups at baseline (p=0.118), 1 month (p=0.147), or 3 months (p=0.095), although a trend toward better long-term QOL in adequately nourished patients was observed.

**Table 4 comparative table of dietary pattern (Pre vs Post Surgery)**

| Dietary Pattern | Pre-Surgery (n) | Pre-Surgery (%) | Post-Surgery (n) | Post-Surgery (%) |
|---|---|---|---|---|
| Cardiac Diet (Low Salt) | 0 | 0.0% | 210 | 84.0% |
| High Fat Diet | 74 | 29.6% | 0 | 0.0% |
| High Protein Diet | 0 | 0.0% | 9 | 3.6% |
| High Salt Diet | 58 | 23.2% | 0 | 0.0% |
| Irregular Diet | 65 | 26.0% | 0 | 0.0% |
| Liquid Diet | 0 | 0.0% | 16 | 6.4% |
| Normal Diet | 0 | 0.0% | 15 | 6.0% |
| Normal Mixed Diet | 53 | 21.2% | 0 | 0.0% |

Before surgery, the predominant dietary patterns were high fat (29.6%), irregular (26%), and high salt intake (23.2%). However, postoperatively, there was a complete shift toward structured therapeutic diets, with 84% of patients adopting a cardiac low-salt diet. No patients continued high fat, high salt, or irregular dietary habits after surgery, indicating highly effective postoperative nutritional counseling and compliance.

## DISCUSSION

In the current prospective observational study (n=250), inflammation (CRP Day 1→Day 7), recovery (wound healing score, ambulation), and quality of life (baseline→1 month→3 months) improved overall, with more favorable trends in the adequately nourished group, although several between-group comparisons were not significant. This is biologically plausible and generally in line with the current evidence that nutritional status affects surgical resilience, immune function, and recovery, but that early postoperative inflammation following cardiac surgery is complex and multifactorial, and not always strongly influenced by nutritional status alone.

### Nutrition and postoperative risk/complications

Malnutrition, often defined by low serum albumin, has been identified as a negative prognostic factor in cardiac surgery. Rich et al. found that hypoalbuminemia in elderly patients undergoing cardiac surgery was a predictor of increased postoperative complications and hospital stay, emphasizing the role of albumin as a useful marker of perioperative risk [10]. Likewise, a clinical evidence review by Karas et al. concluded that low preoperative albumin is a consistent predictor of adverse outcomes following cardiac surgery, although the threshold value and the role of supplementation are unclear [11]. These data support the clinical rationale of your study to include albumin and nutritional risk as essential variables.

In addition to the role of albumin alone, studies based on screening tools have also shown that nutritional risk, as identified by these tools, is a predictor of adverse outcomes. Lomivorotov et al. showed that malnutrition, identified by tools such as MUST and NRS-2002, is a predictor of increased postoperative complications and ICU stay in patients undergoing cardiac surgery with cardiopulmonary bypass [4]. More recently, Oshima et al. found that MUST was effective in predicting postoperative functional decline (ADL) and outcomes in patients undergoing cardiovascular surgery, further emphasizing the importance of systematic nutritional screening [5].

### Nutrition and inflammatory response (CRP)

In your data, CRP showed a gradual decrease from Day 1 to Day 7 in all nutritional groups, with only small differences between them. This is consistent with the fact that the inflammatory response following cardiac surgery, particularly cardiopulmonary bypass, is strong and multifactorial, and thus not strongly influenced by nutrition. A study on nutrition and myocardial inflammatory response during CABG indicated that perioperative nutritional support did not strongly stimulate or inhibit myocardial inflammatory response, justifying the small differences between groups in the acute phase [5].

However, interventional and immunonutrition studies have indicated that specific nutritional products may have an effect on inflammatory mediators and recovery in specific situations. A randomized study (Svetikienė et al.)[] in patients undergoing cardiac surgery assessing postoperative immunonutrition indicated immunologic effects and examined the modulation of inflammation, justifying the general concept that nutrition may affect postoperative immune status [19]. Moreover, a recent report of a randomized trial (Peter Bruins et al.)[] discussed immunonutrition formulations in cardiac surgery patients, particularly glutamine/arginine/HMB combinations, with results including reduced ICU and hospital stay, and a trend toward decreased inflammatory markers in specific situations [7]. These studies, in total, justify the observation that in your data, there are trends but not strong statistical differences, possibly due to the fact that the acute inflammatory response may require larger sample sizes, more precise phenotyping, or specific interventions to clearly distinguish differences.

### Recovery parameters (wound healing, ambulation, ICU/hospital course)

Your results demonstrated better wound healing scores and ambulation trends in the adequately nourished group. This is in line with perioperative nutritional literature suggesting that early postoperative nutritional adequacy is associated with improved wound healing and decreased complications in the surgical patient. A general review of perioperative nutritional support suggests that early postoperative nutritional support is associated with decreased infectious complications and ICU and hospital use in the surgical population, suggesting the clinical relevance of your trends [5]. While not all reviews are cardiac-specific, the pathophysiology (protein-energy supplementation, immune function, tissue repair) is generally relevant.

### Quality of life after valve surgery and recovery

In your study, QOL improved from baseline to 1 month and 3 months in all nutritional groups, with higher mean scores in the adequately nourished group at each time point. This is in line with the established evidence that valve replacement generally improves QOL over time. Sedrakyan et al. demonstrated significant QOL improvement following aortic valve replacement, with postoperative QOL scores improving toward population norms over time [18]. Similarly, van Geldorp et al. demonstrated significant improvements in physical function and related domains following aortic valve replacement

over longer-term follow-up [20].

Your QOL data trends also correlate with the finding that a complicated postoperative course may attenuate QOL improvements. Hellgren et al. found decreased physical health QOL in patients with a complicated postoperative course requiring prolonged intensive care following valve surgery, suggesting that the quality of recovery affects subsequent QOL [12]. More recently, a review of SF-36 changes following heart valve surgery again suggests that QOL improvements are seen but are risk-adjusted and postoperative course-dependent [11]. This again supports your conclusion that nutritional sufficiency—potentially improving recovery—may indirectly support improved QOL, even if differences in acute postoperative inflammation are small.

**Interpretation and implication of existing literature**

In aggregate, existing studies have clearly indicated that malnutrition/hypoalbuminemia and nutritional risk are associated with adverse postoperative outcomes in cardiac surgery [1–4], while interventional nutrition/immunonutrition trials have suggested potential benefit in select patients and outcomes [6–8]. Meanwhile, the acute postoperative inflammatory state is complex and not necessarily strongly affected by typical nutritional differences [5]. Your findings of consistent improvement and directionally favorable effects of nutritional sufficiency on recovery and QOL again fit well within this existing literature framework and suggest the important practical implication that postoperative pathways for valve surgery should include systematic assessment and optimization of nutritional status.

## 4. CONCLUSION

The current prospective observational study assessed the effects of postoperative nutritional status on inflammation, recovery parameters, and quality of life in 250 patients undergoing cardiac valve replacement surgery. The results showed that the levels of inflammatory markers, specifically C-reactive protein, gradually decreased from postoperative Day 1 to Day 7 in all nutritional categories, indicating the natural course of the postoperative inflammatory response. Although there were no statistically significant differences between the adequate and poor nutritional status groups regarding early inflammatory markers, patients with adequate nutritional status showed consistently favorable trends.

Recovery parameters, such as the wound healing score and ambulation time, were also relatively favorable in the adequately nourished group. Moreover, quality of life scores were significantly improved over time in all patients, with higher mean scores in patients with adequate nutritional status at baseline, 1 month, and 3 months postoperatively. Although the differences between groups were not statistically significant in all comparisons, the favorable trends in all analyses indicate a clinically significant association between postoperative nutritional adequacy and improved functional recovery and quality of life.

In conclusion, the current study emphasizes the potential role of systematic nutritional assessment and optimization in the postoperative management of patients undergoing cardiac valve replacement surgery. Adequate nutritional status may play a role in improving recovery, wound healing, and quality of life outcomes, even if its role in modulating early inflammatory markers is not significant. Incorporation of routine nutritional assessment and optimization programs into cardiac rehabilitation protocols may improve patient outcomes.

Large-scale randomized controlled trials with extended follow-up periods are recommended to establish causal associations and develop evidence-based nutritional guidelines in cardiac surgery.

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