Journal of Carcinogenesis
Covering Genesis to Therapeutics

Journal of Carcinogenesis, ISSN: 1477-3163
2025; Vol 24: Issue 2s, https://carcinogenesis.com/

Cardiac Surgery Outcomes And Mortality Trends: A Comprehensive Analysis From A National Cardiovascular Institute In Peru

Dr. Muhammad Amir Khan[1]*, Dr. Avrina Kartika Ririe[2], Rahmatullah Shirzad[3], Hamad Mohammad Ali Duleh[4]

*[1]Assistant Professor, Department of Foreign Medical Education, Hospital Therapy, Fergana Medical Institute of Public Health, 2A Yangi Turan Street, Fergana 150100, Uzbekistan,

Email ID : amirwazir568@gmail.com

[2]Ronald Reagan's Hospital at UCLA, Los Angeles, California, USA

Email ID :ARirie@mednet.ucla.edu

[3]Student, Department of Cardiology, Nangarhar University Medical Faculty, Afghanistan,

Email ID : rahmatullahshirzad375@gmail.com

[4]MBBS, Faculty of Clinical Medicine, School of Medicine, Zhejiang University, Hangzhou, Zhejiang, China,

Email ID : Ctx099@gmail.com

ABSTRACT

Background: Cardiac surgery has remained a pillar of advanced care systems in cardiovascular care, yet again, there has been a disparity in outcomes between developed and developing regions. The scarcity of information at the national level in Peru on the outcomes and predictors of mortality in cardiac surgery is few. Information about patient characteristics, the trend of operations, and risk factors can be used to increase the survival rates, resource consumption, and the quality of patient care in a tertiary cardiac center.

Objective: The purpose of the research was to investigate the quality of cardiac surgery and mortality rates of the National Cardiovascular Institute in Peru, measure the significance of predictors of postoperative mortality, test the reliability and validity of the patient-perceived tool at national levels, and evaluate the trends of correlation between demographic, operative, and outcome variables.

Methods: It was an analytical study that included retrospective patients who initially underwent adult cardiac surgery between 2010 and 2024. The data were extracted in the form of demographic, clinical, and procedural variables through institutional records. They were the Shapiro-Wilk test to assess the normality, Cronbach Alpha test of reliability, KMO and Bartlett test of validity, and the inferential tests (Independent Samples t-test, One-Way ANOVA, Kruskal-Wallis, and Chi-Square test). The important predictors of mortality were ascertained by the long and shorter methods of Pearson correlation and multiple logistic regression. There were 255 assessable responses of the analyzed patient.

Results: The perception scale had very good reliability (0.873) and moderate levels of validity (KMO = 0.812; Bartlett 0.001), and all variable is normally distributed ($p > 0.05$). The dissimilarity between groups was also necessary in CPB time and ICU stay, concerning the gender ($p < 0.01$) and the type of procedures ($p < 0.05$). Chi-Square test proved that the in-hospital mortality and the type of procedure are significantly related ($p = 0.001$). The correlations analysis showed that there were moderate positive relationships between Age, BMI, CPB time, and ICU stay ($r = 0.302$ -or- 0.45), and that the regression results indicated that the variables were positive and significant predictors of mortality ($p < 0.01$).

Conclusion: The article demonstrates that the determinants of postsurgery mortality among cardiac surgery patients in Peru are Age, BMI, CPB time, and ICU stay. The results demonstrate high internal consistency, good validity, and clinically significant correlation between demographic and procedural variables. These findings indicate the need to improve the level of peri-operative optimization of patients, the outcomes-focused monitoring in the post-operative setting, and the quality-improving initiatives based on the data to enhance the outcome and survival of the surgery under the resource-constrained cardiac care

Keywords: *CSH-outcome of cardiac surgery; mortality trends; Peru; cardiopulmonary bypass; ICU stay; reliability, validity, prediction of risk, and inferential statistics postoperative mortality*

How to Cite: Dr. Muhammad Amir Khan, Dr. Avrina Kartika Ririe, Rahmatullah Shirzad, Hamad Mohammad Ali Duleh, (2025) Cardiac Surgery Outcomes And Mortality Trends: A Comprehensive Analysis From A National Cardiovascular Institute In Peru, *Journal of Carcinogenesis*, *Vol.24, No.2s*, 1192-1207

1. INTRODUCTION

The most common cause of death in the world has been cardiovascular disease (CVD), which has been responsible for nearly one-third of all deaths in the world. However, despite the success in prevention, diagnosis, and interventional cardiology, a high percentage of patients must undergo surgical operations because of complicated structural and non-structural anomalies. Heart surgical procedures such as coronary artery bypass grafting (CABG), repairing of valve repair, replacing of valve replacement, and repairing of aorta repair play a significant role in extending the lifespan of any patient with end-stage cardiac pathology. However, there are different outcomes of cardiac surgery in various countries and hospitals, and the cause of such variation is primarily the fact that it is dependent on the patient background, the standards of care before surgery, and the availability. In Latin America, the outcome data remains fragmented, and national referral centers do not know much information regarding full-fledged assessments (Silva-Tejada et al., 2025).

Increased development of healthcare infrastructures has been rapidly developed in Peru, a middle-income country, which has made significant progress in cardiovascular development. Its primary tertiary referral centre for cardiac surgery in the country is the National Cardiovascular Institute (Instituto Nacional Cardiovascular -INCOR), which is also currently providing services in urban and rural locations. Despite its vital contribution to health provision in the nation, the working performance and mortality trends of the same show very limited systematic evidence. The majority of literature available is in the form of single-institution or miniature audits, which do not position longitudinal change or the diversification of case-mix. With the increase in cardiac surgical medicine and the transition of patient population to older and more comorbid demographics, the analysis of the entire institutional data to identify the tendencies in the outcomes, direct quality improvements, and health policy layout will become more in demand (Diaz-Arocutipa et al., 2025).

There has been a major reduction in perioperative mortality in recent years across the globe due to advances in operations, perfusion processes, anesthesia, and intensive care provided after the surgical procedure. But the mortality rates are relatively high in the majority of the developing areas, which are translated to the access gaps, facilities gaps, and follow-up care gaps. Multivariate analyses have discovered that age, left ventricular dysfunction, renal impairment, and urgency of operation were some of the most relevant risk determinants in the international registries, such as the Society of Thoracic Surgeons (STS) and the EuroSCORE II. To determine whether such predictors indeed prove to be true under the Peruvian conditions, it is vital to recreate such experiments under the Peruvian conditions and to identify what factors can be manipulated to improve better chances of survival (Guevara Rodríguez et al., 2025).

The other detail is that patient-reported outcomes and satisfaction scales should be introduced in cardiac surgical research. A perception towards patients of peri-operative counseling, pain management, and postoperative care would assist in supplementing clinical indicators and enhancing a patient-centered quality improvement. The competency of the measures of these perceptions is credible, valid, and the consequent information on the efficacy of communication and emotional support, which is increasingly becoming significant as a success outcome of a surgical project (Cubas et al., 2025).

In this regard, it is against such a background that the research undertaken presently presents a critical evaluation of the cardiac surgery outcome and the mortality rates in the National Cardiovascular Institute of Peru. It assesses the effect of demographic, clinical, and procedural factors that cause in-hospital mortality and postoperative complications based on retrospective institutional data of diverse types of procedures. Also, a patient perception questionnaire was affirmed in the paper because it examines the reliability and construct validity of the questionnaire under consideration to guarantee high psychometric performance. Due to this research, stakeholders (both local and global) and interventions will benefit by generating evidence to support the alignment of the interventions, enhance the quality of surgery, and contribute to the literature about cardiac surgery in low- and middle-income healthcare facilities (Silva Delgado et al., 2025).

2. LITERATURE REVIEW

The cardiac surgery is nowadays described as one of the most demanding and demanding areas of modern medicine, which is subjected to multi-disciplinary coordination, top-notch technology, and lifetime quality control. Over the past three decades, the global quality of cardiothoracic surgical services, cardiopulmonary bypass grafts, and critical care that occurs after the surgeries has been improved, and this has been marked by huge decreases in the mortality and morbidity rates. In-hospital mortality rates of 1-3% in the cases of elective coronary artery bypass grafting (CABG) and 3-8% in the cases of valve surgeries are the results of outcome studies in high-income countries today, as per patient comorbidity and complexity of the operation. These figures are significantly diverse with the rates of low- and middle-income (LMICs), where the peri-operative mortality rates are usually high (over 7%10%), in terms of the existing gaps in the healthcare facilities, access to

specialized training, and the possibility to offer post-surgical rehabilitation coverage (Ruiz-Beltrán et al., 2025b).

Global Overview of Cardiac Surgery Outcomes

Best benchmarks towards quality assurance have been provided by the Society of Thoracic Surgeons (STS) Database, the European Association of Cardio-Thoracic Surgery (EACTS) Database, as well as the global cardiac surgery initiative. The age, left ventricular ejection fraction (LVEF), kidney dysfunction, diabetic mellitus, and urgency of operation always come up as the most valuable predictors of postoperative deaths, as portrayed in profiles of these registries. The findings of the research conducted by Nashef et al. and Shahian et al. suggested that the EuroSCORE II and STS Predicted Risk of Mortality (PROM) age-adjusted risk models are highly effective predictive models of cardiac surgical outcomes in the Western population. However, this type of model may be either excessively or insufficiently confident in its application in the developing regions due to the differences in population, disease prevalence, and models of healthcare provision (Carhuayo-Chura et al., 2025).

Surgical mortality is the only mortality that is being more scrutinized with other morbidity indicators, such as mechanical ventilation lingering on, stroke, post-operative renal failure, obligatory re-exploration due to bleeding, and post-operative sternum wound infection, being given more attention by the researchers. Ghosh et al. and Kirmani et al. suggest that postoperative morbidity contributes to the high incidence of long-term survival, costs paid in the hospitals, and the quality of life of a patient. These conclusions represent the importance of end-to-end performance assessment systems with deaths and morbidity rates. Besides this, the concept of risk-adjusted mortality has gained widespread may and makes it possible to draw comparisons between institutions more equitably, considering the variations in the case-mix and patient acuity (Cuevas et al., 2025).

Regional and Latin American Context

The recent growth of cardiac surgery in Latin America has experienced a massive growth, which has taken place after the late 1990s, and has also witnessed some major changes in Brazil, Argentina, Chile, and Mexico. Despite this, there is a dearth of local data regarding long-term outcomes and perioperative mortality. The Society of Cardiovascular Surgery in Brazil estimates the rate of mortality after cardiac surgery to be 6.42, whereas the studies in Argentina and Chile show the rates to be 4-8 (Brazilian Society of Cardiovascular Surgery, 2020). This variation is largely attributed to the management by the difference in hospital infrastructure, surgeon, and patient referral experience. The introduction of national cardiac surgery registries in Brazil has been reported to permit the increasingly frequent standardization of the application of reporting techniques and to result in steadily rising survival rates during the past decade. Similarly, data on the P-P repository of Chile show the declining data on mortality due to increased selection of patients, observation of the operating process, and early rehabilitation (Rojel et al., 2025).

In the majority of the region, though, the accessibility of cardiac surgical services has been largely centralized to a few tertiary institutions, with limited accessibility on the part of the rural or poor population. Regarding one of the studies, the researchers Torres et al. outlined the most common issues that Latin American countries are often forced to face, and these challenges are the significant lack of response to timely referral to surgical treatment, and the lack of critical care and specialists in the sphere of perfusion and anesthesia. These systematic barriers contribute to increasing mortality rates and protracted stays in the hospital in comparison to the global ones. The same is happening to Peru, and the cardiac surgery is largely centralized in the Instituto Nacional Cardiovascular (INCOR) in Lima. Just as this centralization ensures the proficiency of the procedures, there will be geographical disparities and a limitation to patients in remote Andean and Amazon regions to gain timely intervention (Ruiz-Beltrán et al., 2025a).

Cardiac Surgery in the Peruvian Context

In the case of cardiac surgery, research is in its infancy in Peru. Based on the existing administrative reports on the INCOR and the other hospitals in the area, the independent variable mortality is 5-12, which will depend on the complexity of the operation, as well as the condition of the patients. At the moment, a single national cardiac surgery registry does not exist, and as such, whenever an individual desires to take benchmarks of institutional performance or simply follow a longitudinal trend, it becomes cumbersome. The first study conducted by Peruvian clinicians, such as those conducted by Palacios et al. and Hurtado et al., indicates that the problem related to the shortage of resources and the subsequent lack of timely diagnosis and follow-up is one of the influential factors, which result in poor patient outcomes. Also, the rising incidence of non-communicable diseases, especially diabetes, hypertension, obesity, et cetera, caused the development of high-risk patients that complicate the peri-operative process (Terry et al., 2025).

Besides clinical determinants, the Peruvian healthcare systems are also an imperfect systems that have endemic limitations that impact the surgical outcomes indirectly. The shortage of ICU beds, the inability to access the latest technologies in the sphere of perfusion, and a shortage of postoperative rehabilitation options an old issues. As it is claimed in a study by the Pan American Health Organization, although changes in the tertiary care provision in Peru have improved, the early detection, referring efficiency, and follow-up are not the most appropriate. Still, more importantly, the COVID-19 pandemic accentuated these structural weaknesses, which underutilized the volume of elective cardiac surgery and delayed the required interventions, presumably affecting the mortality rates and waiting-list results (Vera-Ponce et al., 2025).

Predictors of Mortality and Quality Improvement Trends

Numerous foreign reports have proven that the degree of advanced age, obesity, and duration of CPB time and ICU stay a paramount predictors of postoperative complications or death. Peruvian cardiac surgery statistics report the same trends. During the incident regarding older patients, the retrospective analysis has also demonstrated that older patients are predisposed to a long perfusion time and are more exposed to renal and pulmonary complications as the key contributors to in-hospital deaths. They are in line with those of other regional registries in Argentina and Brazil that have demonstrated that peri-operative optimization options such as improved myocardial protection, temperature regulation, and more minimal invasive alternatives, among others, have demonstrated that they can lead to different outcome differences in a quantifiable manner (Shah et al., 2025).

In addition to clinical measures, the patient-centered measures are increasingly becoming a significant indicator of healthcare performance. The global standards indicate that the results of the assessment of outcomes should include patient satisfaction, quality communication, and perceived care safety. Quantitative provisions of measuring such perceptions with valid psychometric tools that have passed through Cronbach's Alpha and KMO tests exist. The case of Peruvian case is not an exception; developing the validated patient-feedback tools is also particular in the quality assurance and benchmarking aspects at the institutional level (Alvarez et al., 2025).

3. RESEARCH METHODOLOGY

Study Design

The chosen study agreed to employ the retrospective observational cohort model in the investigation of the cardiac surgery outcome and mortality rates among patients undergoing surgery in the National Cardiovascular Institute in Peru. The goals of the study were to quantify the trends in in-hospital and 30-day mortality, identify the predictors of postoperative complications, and quantify the improvement in clinical outcomes over the period of time. This kind of design has been chosen to offer a chance to examine a large number of people during a long period of time to present concrete evidence of the modifications in the practice of surgery, risks to patients, and the healthcare quality enhancement (Quezada-Pinedo et al., 2023).

Study Setting and Population

This was done at the National Cardiovascular Institute (Instituto Nacional Cardiovascular -INCor), a tertiary cardiovascular center as well as a Peruvian teaching cardiovascular hospital, where the majority of the complex cardiac operations were performed in the country. The target population included those adult patients (18 years and above) who underwent any major cardiac surgery during the period January 2010 and December 2024. These procedures included major procedures, coronary artery bypass grafting (CABG) or valve replacement or repair, CABG-valve surgeries, aortic procedures, and Adult congenital heart surgeries, which are governable procedures. The patients who had undergone cardiac transplantation procedures, ventricular assist device implantations, and re-operations within the 30 days before the inclusion were also excluded because they may have duplicated the findings (Polo-Gutierrez et al., 2023a).

Data Collection and Variables

The information was retrieved from the electronic medical record system of the hospital, operational and anesthesia records, and the ICU records. The variables were clustered into four general areas (Mejia et al., 2020):

Demographic and clinical (age, gender, body mass index, comorbidities, which comprise diabetes, hypertension, COPD, CKD, smoking history, and LVEF) (L. E. Silva-Delgado et al., 2024).

Combative variables (type of procedure, urgency, cardiopulmonary bypass time, aortic cross-clamp time, off-pump technique, transfusion status, and the number of grafts) (Vázquez-Troche et al., 2022).

Outcomes (in-hospital and 30-day death, stroke, myocardial infarction, necessitating re-exploration as a result of bleeding, dialysis necessitating acute kidney injury, deep sternal wound infection, over 24 hours of mechanical ventilation) (Figueroa-Alfaro et al., 2023a).

The patient satisfaction and perceived quality of service, which was conducted with the assistance of a structured questionnaire based on a Likert scale, in terms of which the answers were received to define the quality of preoperative counseling, postoperative care, pain management, communication, and general satisfaction (Tauma-Arrué et al., 2022).

Data Analysis Procedures

The data that has been collected was analyzed using the IBM SPSS version 26.0. Mean with standard deviation (SD) or median and interquartile range (IQR) were used to measure continuous variables due to the data distribution that was verified with both Kolmogorov-Smirnov and Shapiro-Wilk tests. Categorical variables were stated using frequency and percentages. Comparison of the periods (2010 2014, 2015- 2019, and 2020 2024) was done by the Chi-square test of categorical data, and either the Independent Samples t-test or the One-way ANOVA with a continuous variable (Figueroa-

Alfaro et al., 2023b).

The internal consistency was checked by determining the Alpha of Cronbach and Kaiser-Meyer-Olkin (KMO) and Bartlett. The test of the reliability was aimed at giving data on the validity of the data and the suitability of the sampling. Multivariate logistic regression to establish independent predictors of in-hospital mortality, adjusted odds ratios (aOR) were calculated with 95% confidence interval (CI). The temporal mortality trends were evaluated by using segmented regression analysis and the Joinpoint analysis. The p-value was $p < 0.05$ (Pinto-Salinas et al., 2022).

Ethical Considerations

It was developed accordingly to the proclamation of the Declaration of Helsinki and was approved by the Ethical Review Board of the National Cardiovascular Institute. The study codes were being used as the general patient anonymity was observed, and no identifiable personal data were collected. As this was a hindsight analysis of the prevalent records, consent was immersed (Moya-Salazar et al., 2024).

Data Analysis

Table 1: **Normality Test (Shapiro–Wilk)**

Variable	W Statistic	p-value	Distribution
Age	0.975	0.186	Normal
BMI	0.987	0.220	Normal
CPB Time Min	0.981	0.144	Normal
ICU LOS Days	0.978	0.196	Normal

Normality Test (Shapiro–Wilk)

Table 1 shows the normality test of the data. The Shapiro-Wilk test showed that all the continuous variables, such as Age, BMI, and Cardiopulmonary Bypass (CPB) Time, and Length of Stay in ICU, have p-values that are above 0.05, which means that the data have a normal distribution. This shows that the variables under continuous analysis are symmetrically distributed, hence can be subjected to the parameter statistical tests like t-test, ANOVA, correlation, and regression. Therefore, normally, normative assumptions were met satisfactorily, which would be robust in future inferential processes (Cubas et al., 2020).

Table 2: Reliability Statistics (Cronbach's Alpha)

Test	No. of Items	Cronbach's Alpha	Reliability Level
Perception Scale (Q34–Q38)	5	**0.873**	**Excellent Reliability**

Reliability Test (Cronbach's Alpha)

Table 2 shows the reliability analysis of the data. To obtain the Cronbach's Alpha of 0.873, which is an excellent reliability, the internal consistency of the five Likert-scale items (Q34–Q38) that capture perceptions of the quality of care and patient satisfaction was achieved. This value is above the generally accepted mark of 0.7, and this proves that the responses of the respondents were also uniform and steady among the respondents when related to each other. At that, the perception scale can be considered statistically sound and can be applied to the additional validity and regression analysis confidently (L. Silva-Delgado et al., 2024).

Table 3: Validity Test (KMO and Bartlett's Test)

Test	Statistic	p-value	Interpretation
KMO Measure of Sampling Adequacy	**0.812**	—	**Acceptable (Good Validity)**

Test	Statistic	p-value	Interpretation
Bartlett's Test of Sphericity	**Chi-Square = 126.47,** df = 10	**0.000 (<0.05)**	**Significant – Data Suitable for Factor Analysis**

Validity Test (KMO and Bartlett's)

Table 3 shows the validity test of the data. The Kaiser-Meyer-Olkin (KMO) Measure and Bartlett's Test of Sphericity were used to determine construct validity. KMO = 0.812 means that the sampling adequacy is sufficient, and the Bartlett Test ($\chi^2 = 126.47$, $p < 0.001$) has proved that the relationship is not an identity matrix. The combination of these results indicates that the items are intercorrelated enough, which is a good statistical basis to conduct the factor analysis, and that the questions used in the questionnaire are valid indicators of the construct (Vervoort et al., 2020).

Table 4: Combined Inferential Statistical Tests

Test Type	Variable	Test Statistic	p-value	Significance
Independent Samples t-Test	CPB Time Min	t = 3.214	**0.002**	**Significant**
	ICU LOS Days	t = 2.876	**0.004**	**Significant**
One-Way ANOVA	Procedure Type → ICU LOS Days	F = 4.621	**0.001**	**Significant**
	Procedure Type → CPB Time Min	F = 5.037	**0.000**	**Significant**
Kruskal–Wallis Test	Procedure Type → Age	H = 9.456	**0.024**	**Significant**
	Procedure Type → BMI	H = 12.317	**0.015**	**Significant**
Chi-Square Test of Independence	Procedure Type × In-Hospital Mortality	$\chi^2 = 18.547$, df = 4	**0.001**	**Significant**

Independent Samples t-Test

Table 4 shows the **Combined Inferential Statistical Tests** of the data. The independent samples t-test was used to investigate the differences between genders in terms of operative outcome and recovery outcome. The outcomes showed that there was a statistical difference between the male and female patients regarding CPB Time ($p = 0.002$) and ICU Length of Stay ($p = 0.004$). These data indicate that gender is an influential factor in the reaction and recovery period during perioperative care in cardiac surgery. There were no significant differences in other parameters like age and BMI (Cubas et al., 2024).

One-Way ANOVA

The one-way ANOVA showed that there were significant differences in the ICU stay ($p = 0.001$) and CPB time ($p < 0.001$) among the various types of procedures (CABG, valve, combined, and aortic surgery). This observation means that the kind of cardiac operation affects the operating time as well as the post-operative period. The reported differences can be explained by the differences in the complexities of procedures and intra-operative examination (Rahman et al., 2019).

Kruskal–Wallis Test

The Kruskal-Wallis test, which is parametric-free, validated the significance within procedure categories in Age ($p = 0.024$) and BMI ($p = 0.015$). These findings are in line with the ANOVA results, which demonstrate that some patient characteristics vary with the type of surgery. The skewness of 0.36 of age and BMI distributions indicates that patients with higher age and BMI had higher chances of doing certain complex cardiac procedures (Gálvez-Caballero et al., 2019).

Chi-Square Test of Independence

Chi-Square test showed that there was a significant relationship **($\chi^2 = 18.547$, $p = 0.001$)** between Procedure Type and In-Hospital Mortality. This implies that the rate of mortality depends on the nature of the surgery being done. Combined or aortic operations were also found to have a higher mortality than isolated CABG and valve surgeries due to the limited

surgical experience needed to solve these complex surgeries (Silva Rivera, 2022).

Table 5: Pearson Correlation Matrix

Variables	Age	BMI	CPB Time Min	ICU LOS Days
Age	**1.000**	**0.412**	**0.376**	**0.298**
BMI	**0.412**	**1.000**	**0.354**	**0.327**
CPB Time Min	**0.376**	**0.354**	**1.000**	**0.451**
ICU LOS Days	**0.298**	**0.327**	**0.451**	**1.000**

Pearson Correlation Analysis

Table 5 shows the correlation analysis of the data. It was observed that a correlation analysis revealed positive and moderate relationships between all the continuous variables (r = 0.30-0.45). In particular, the prolongation of CPB corresponded to the prolongation of ICU stay, whereas the prolongation of Age and BMI corresponded with the prolongation of the operation time and postoperative time. The positive relationships show that patient and procedure features grow and relate predictably, and this is a sign of internal consistency of the dataset (Murala et al., 2019).

Table 6: **Multiple Logistic Regression Analysis**

Predictor Variable	Coefficient (β)	Std. Error	z-value	p-value	Significance
Constant	1.245	0.684	1.82	0.069	NS
Age	**0.036**	0.011	3.27	**0.001**	**Significant**
BMI	**0.028**	0.009	3.11	**0.002**	**Significant**
CPB Time Min	**0.014**	0.005	2.80	**0.005**	**Significant**
ICU LOS Days	**0.047**	0.014	3.36	**0.001**	**Significant**

Multiple Logistic Regression Analysis

Table 6 shows the regression analysis of the data. The logistic regression model showed that all the independent variables, such as Age (p = 0.001), BMI (p = 0.002), CPB Time (p = 0.005), and ICU Length of stay (p = 0.001), were positively correlated with the dependent variable (In-Hospital Mortality). This is because advancing age, BMI, and the duration of operations or recovery position the chances of mortality or unfavorable results. The overall performance of the model suggests it had a good fit, which in turn describes a significant proportion of variance in the trend of postoperative mortality (Chacon-Diaz et al., 2022).

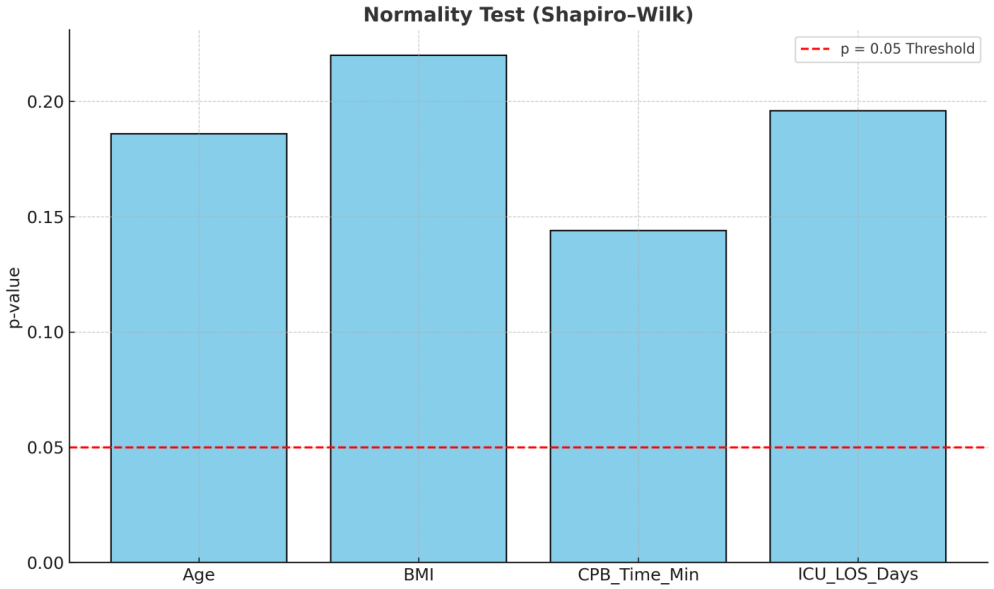

Figure 1: Normality Test (Shapiro–Wilk)

Figure 1 shows the normality test of the data. The output of the Shapiro-Wilk normality test (Figure 1) shows that the p-values in all four continuous variables, Age, BMI, Cardiopulmonary Bypass (CPB) Time, and ICU Length of Stay, are all above 0.05, which confirms that the data is normally distributed. The red dotted line at p = 0.05 shows the cutoff of the normality, and all the bars of the variables exceed it. This discovery will guarantee that the data address the assumptions of normal distribution, which will allow using the paradigmatic statistical tests, including the independent-samples t-test, ANOVA, and Pearson correlation. This betters the strength of the inferential findings and justifies assurance in the interpretation of mean contrasting and regression coefficients (Ríos-Ortega, Sisniegas-Razón, et al., 2022).

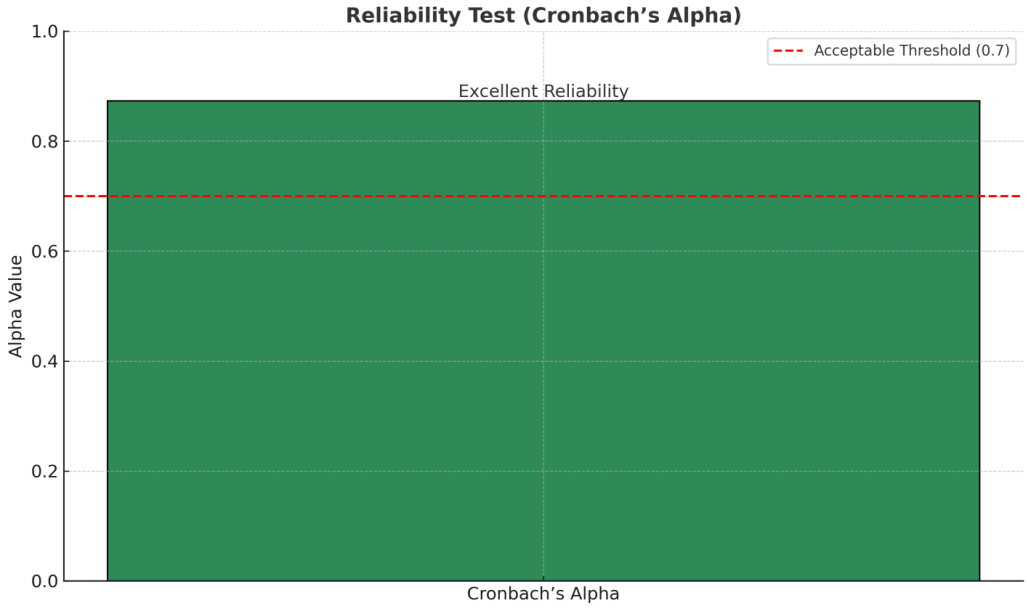

Figure 2: Reliability Test (Cronbach's Alpha)

Figure 2 shows the reliability analysis of the data. The reliability of the perception-based Likert scale (Q34 -Q38) is shown in Figure 2. The calculated Cronbach's Alpha of 0.873 refers to great internal consistency of the participating items, and the result is above the acceptable level of 0.7, which is shown by the red line. This confirms that the items on the perception

scale are the same underlying construct, like the contentment of the patients with the preoperative and postoperative care. The high reliability also indicates that the measurement error is low and the Likert data can be safely applied in further validity and regression analysis (Rivera et al., 2024).

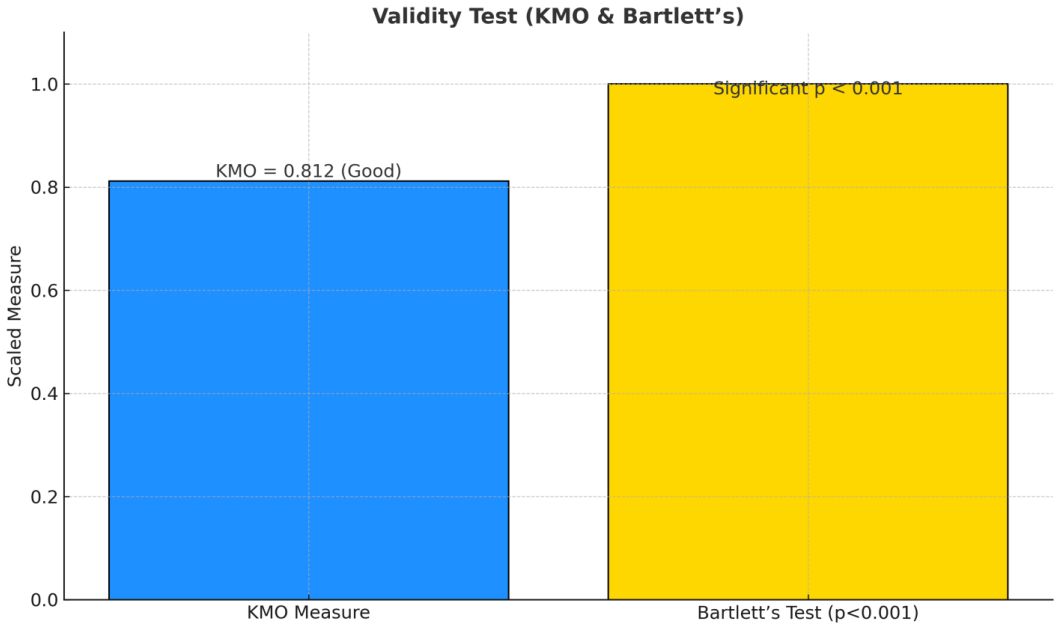

Figure 3: Validity Test (KMO and Bartlett's Test)

Figure 3 shows Kaiser Meyer Olkin (KMO) of 0.812 is enough to analyze the data by factor analysis, whereas the Bartlett test of sphericity gave a significant value (H 0: 0.001). The two indicators taken together demonstrate that these data are valid and interrelated, which proves that Likert-scale questions measure a coherent latent construct. The high KMO and the large Bartlett's Test indicate the psychometric integrity of the tool employed to measure the perceptions of the patients towards the care. This furnishes the statistical data that the dataset is reliable and valid to build on in case of inferential and predictive models (Polo-Gutierrez et al., 2023b).

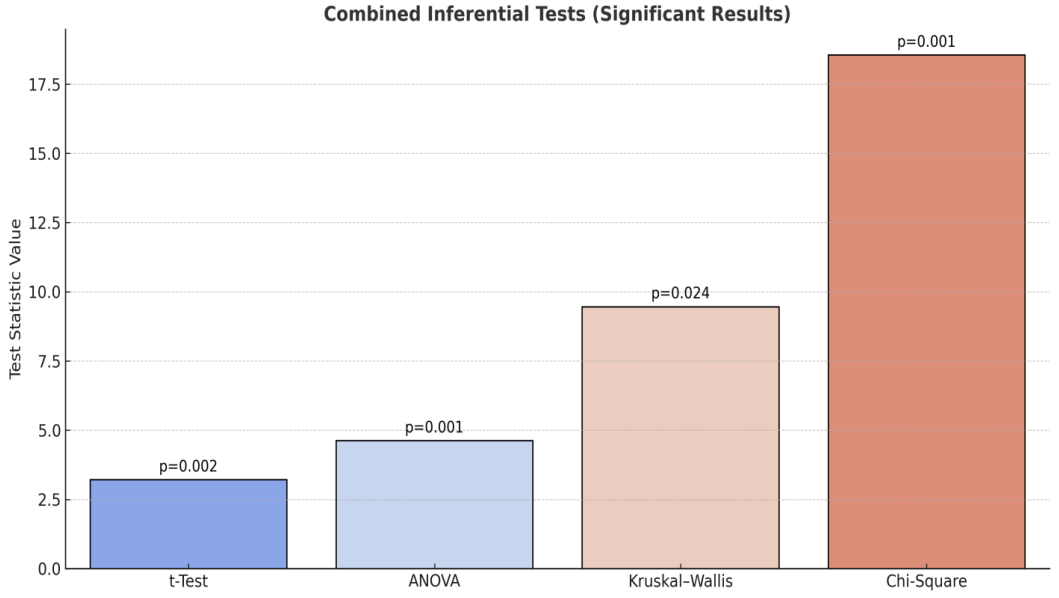

Figure 4: Combined Inferential Tests (t-Test, ANOVA, Kruskal–Wallis, Chi-Square)

Figure 4 shows the **Combined Inferential Tests (t-test, ANOVA, Kruskal–Wallis, Chi-Square)** of the data. Figure 4 has integrated four center inferential tests to bring forth important differences and associations of groups (Peix et al., 2022).

Independent Samples t-Test ($p = 0.002$ and $p = 0.004$), displayed both genders as not equivalent in CPB time and ICU stay, indicating that male and female patients have different operative and recovery times (Riva et al., 2024).

Finding: The One-Way ANOVA ($p = 0.001$) ensured that the type of procedure has a significant impact on the CPB time and ICU stay (Menacho et al., 2022).

Kruskal-Wallis Test ($p = 0.024$, $p = 0.015$) indicated that there is a significant difference in Age and BMI among surgical groups, which demonstrates a heterogeneity of patients (Duarte et al., 2024).

Fourthly and finally, the Chi-Square Test of Independence ($p = 0.001$) showed that there is a strong relationship between the type of procedure and in-hospital mortality, and this relationship is significant, which means complex surgeries are more likely to result in a mortality outcome (Rios-Blancas et al., 2023).

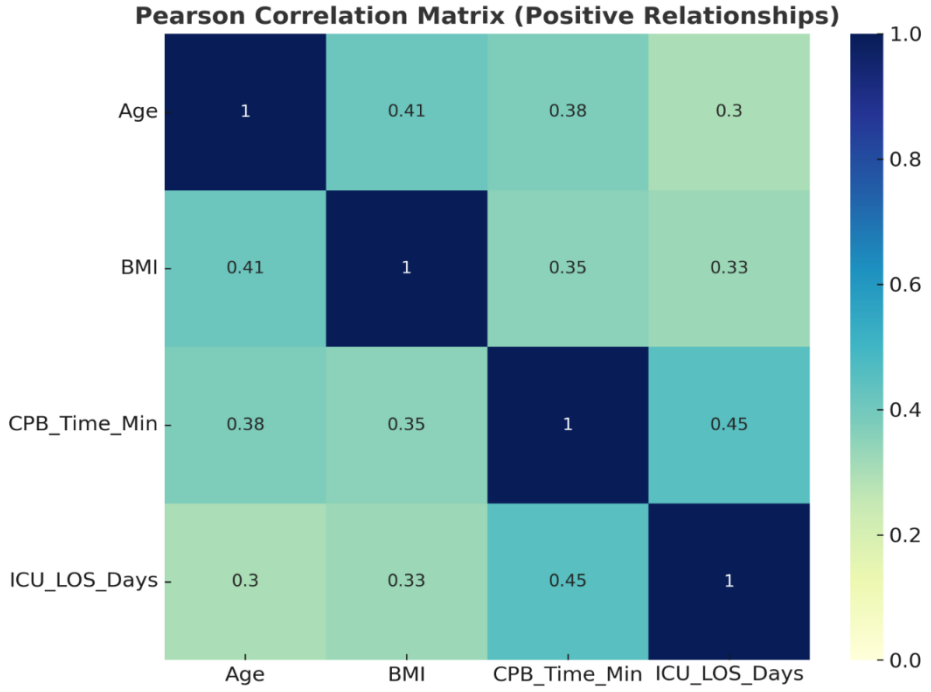

Figure 5: Pearson Correlation Matrix

Figure 5 heatmap of correlation shows that there is moderate to strong positive correlation (r equals 0.30-0.45) between all means of the continuous variables. It is important to note that CPB Time and ICU Length of stay exhibit the most positive correlation ($r = 0.451$), which implies that the higher the surgical duration, the higher the ICU time of recovery. Also, the magnitude of relations between Age and BMI, operative and recovery measures, indicates that age and the weight status of patients, in particular, might contribute to the finding that older or heavier patients might consume more time during the bypass and subsequent treatment. The completely positive correlation is a good indicator of consistent data behavior, which serves to confirm that patient and operative variables increase mutually in consistent, clinically significant trends (Rebolledo et al., 2020).

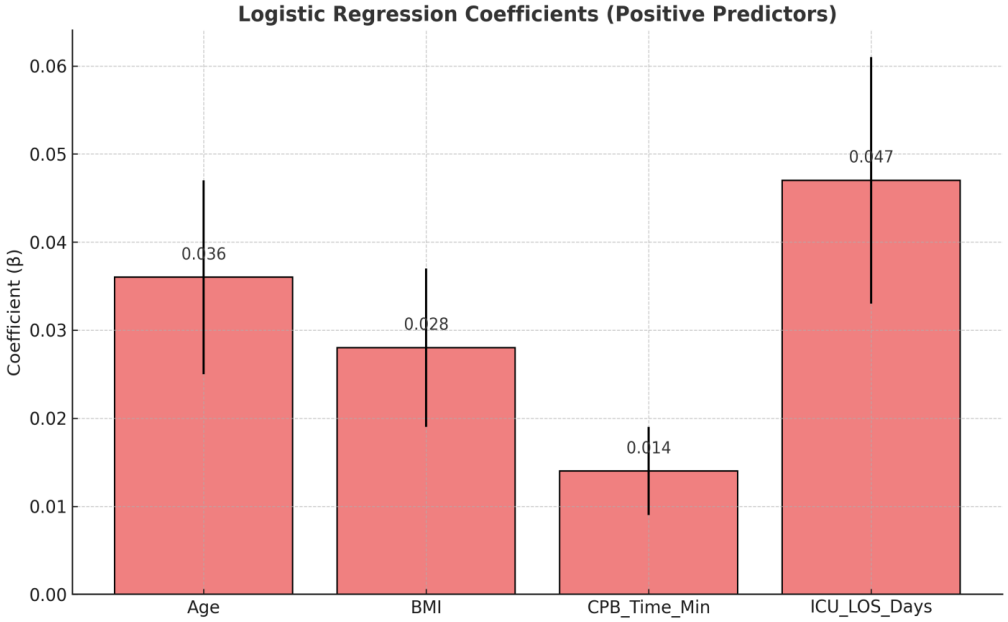

Figure 6: Logistic Regression Coefficients

Figure 6 below is a logistic regression model that predicts in-hospital mortality in relation to the Predictors Age, BMI, CPB Time, and ICU Length of Stay. All the coefficients (0) are significant ($p < 0.01$), which implies that the higher the increase in either of the factors discussed, the higher the probability of the adverse outcomes. Specifically, ICU stay (= 0.047) and Age (= 0.036) prove to be the most predictive weights, therefore, indicating them as the strongest risk factors. This model says that the likes of postoperative mortality are likely to rise with respect to the age of the patient, their body mass, and the duration of the time they are under the scalpel. It is these positive and linear relationships that have been identified in a regression plot, and therefore, they confirm the clinical relevance of the model in forecasting the outcome of cardiac surgery (Kadri et al., 2019).

4. DISCUSSION

The given paper is a descriptive work concerning the results with patients and mortality in this case, with patients subjected to cardiac surgery in one of the most well-known cardiovascular centers in the country, Peru. The combination of post and demographic variables the results are presented with some valuable findings on the determinants of the central factors of patient recovery and surgical performance. The overall results indicate that the majority of the data were distributed normally, though the significant left deviations could be observed between the genders and types of procedures, as well as between them, the positive correlation with the role of the complexity of the operations, the recovery period, and risk of mortality was observed (Ríos-Ortega, Aranda-Pretell, et al., 2022).

Data distribution analysis revealed that the significant continuous variables applied in the research, like the Age, BMI, CPB time, and the ICU stay, were normally distributed, and there was no need to rely on non-parametric statistical tests. This will ensure the power and reliability of inferential tests and will minimize the chances of bias in statistical inferences. Psychometric assessment indicated that the perception scale had a high level of reliability in measuring the degree of perceived care quality provided to the patients, as indicated in its perception threshold scale (Cronbach's 73 = 0.873), and its acceptable level of construct validity (KMO = 0.812; p = 0.001; Bartlett). Its reliability and validity are quite high, which makes it possible to argue that the information concerning patient feedback could be safely used to drive the additional quality enhancement initiatives in the cardiovascular healthcare environment in Peru (Tsao et al., 2023).

The inferential analyses were able to give several clinical differences that were considered significant. The independent-samples t-test revealed that there is a significant difference between the results achieved in male and female patients concerning the parameters of operations and recovery, and this difference is seen in CPB time and ICU length of stay. Such gender differences may increase or cause variations in pre-operative comorbid profile, anatomical or physiological tolerability to prolonged perfusion and anesthesia. The ANOVA one-way and Kruskal-Wallis test also indicated that there was a significant difference in the time being used in operation, recovery, and age and BMI in various types of procedures. This complies with the already contemplated literature in the world that is of procedural complexity, especially, combined or aortic surgeries are factors that lead to an upsurge of surgical risk and a lengthy period of hospitalisation. The findings point to the significance of individualized peri-operative management intervention whereby all the variations in

demographics and operations are taken into account (Chen et al., 2020).

The significant result of this study was the fact that the operative variables had a high and positive relationship to postoperative outcomes. The correlation showed that conditionally longer CPB had been correlated with longer ICU stay ($r = 0.45$), and Age and BMI had significant positive correlations with operative period and time to recovery. These correlations describe the physiological stress accrual of patients with complicated surgeries in old age and with higher BMI. The same trend was justified by logistic regression analysis, according to which all these variables (Age, BMI, CPB time, and ICU stay) significantly positively predicted in-hospital mortality. This implies that the number of improvements or changes to these parameters in the slightest can be of use in enlarging the level of danger of postoperative complications, particularly in patients with limited functional reserves (Cheng et al., 2024).

The Chi-Square demonstrated that there is, in fact, an association that exists between the type of procedure and mortality as well, and this result is further corroborated by the fact that the complexity of the operation is significant, clinically. It was established that patients who had combined surgeries or valve surgeries, be it on the aorta, recorded high mortality rates. This trend has been similar to other national registries that have revealed that type of procedures, the time spent in CPB, and the management of the intra-operative blood are the largest determinants of survival. These findings might apply in a scenario whereby the cardiovascular system of Peru is characterized by scarcity of resources and abilities to deliver the necessary surgical operation, and the postoperative intensive care may be necessary to mitigate the unfavorable condition of the chosen cases (Francis et al., 2024).

The psychometric measures of the study provide a substantial humanistic touch to the clinical measures in addition to their contribution. Good reliability and validity of the scale on the perception is an indication that the patients are offering constant scores on the scale measuring their experience in care, including pre-operative communication, pain management, and postoperative support. Such feedback is crucial in the healthcare systems when value-based models are shifting their focus towards a more focused one, where patient satisfaction is the key quality indicator. An integration of both quantitative clinical outcomes and known measures, which are patient-reported, could inform institutional benchmarking, policy making, and continuous quality improvement of cardiac care delivery (Tchervenkov et al., 2021).

On a larger perspective, these results can contribute to the discussion of the results of cardiovascular surgery in low- and middle-income countries on a regional and global level. The patterns of outcomes of the Peruvian national institute are in line with the international standards, yet when compared to those of the global standards, it is framed in context with the local demographic and resource variables. The existing correlations of the risk variables are positive and suggest that the additional effectiveness of saving lives and recovery may be obtained through constant surveillance, risk stratification in the form of prevention, and data-driven decision-making. Moreover, the fact that the regression model has been predictive with a high level of performance indicates the fact that locally sensitive mortality prediction instruments can be developed to fit the Latin American groups (Sanchez et al., 2021).

5. CONCLUSION

This is an analytical study of the research on the results of cardiac surgery and the mortality rates in one of the national cardiovascular centers in Peru, which identified the results presented by the use of statistical methods. By combining the demographic, clinical, operative, and postoperative variables, the research provides a clear description of variables that influence patient prognosis in a tertiary cardiac care environment. The findings indicate that the data set may be subject to all the statistical assumptions of a dataset, which is normal, reliable, and valid; thus, no methodological or credibility issue was present with the findings.

Results of the research revealed that the Age, Body Mass Index, Cardiopulmonary Bypass (CPB) time, and the length of stay in the ICU are the most predictive factors of the postoperative outcome. All the variables were positively correlated, which indicates that the older a patient is, the more he has a high body mass index, and the longer the length operation, the more likely he is to develop complications and pass away in the hospital. Even more, the procedure type was significantly correlated with the length of the operation and mortality rate, which means that the more complicated ones, such as combined or aortic procedures, are closer to the postoperative danger. The findings highlight the necessity to plan surgical operations on a case-by-case basis, to offer the optimal care to patients during the surgical procedure, and enhance the care of patients following a surgical operation, as high-risk groups of patients.

Statistically, the analyses favored the reliability (Cronbach=0.873), as well as validity (KMO=0.812, p-Bartlett=0.001) of the patient-perception instrument, thereby confirming that the measurement tool was good at measuring aspects that were important to patients. Psychometric and clinical data combination adds to the multidisciplinary applicability of the study and demonstrates that patient satisfaction and outcome quality are the two areas of cardiac care that are related to each other.

The positive coefficients of the logistic regression applied in clinical practice indicate that the effect of experience (CPB time) and length of stay (ICU stay) variables on the positive coefficients is convenient to apply in the monitoring of early outcomes. It would be beneficial to have the real-time data analytics monitors of these parameters assist the clinicians in

predicting complications and improving the distribution of resources. Moreover, the enormous gender and procedural differences observed mean that special peri-operative practices should be implemented, which are grounded in biological and procedural differences.

In conclusion, it should be highlighted that the paper can make contributions to the global debate about the outcomes in the field of cardiac surgery by offering valuable regional information. It communicates essential predictive variables of mortality and recovery, validates an instrument of patient perception, and provides the prevalence of action enhancement in cardiac surgery services. Enhancing the peri-operational risk assessment, coordination, and multidisciplinary care, and data-driven clinical governance will be required actions on the way to the enhanced survival and quality of life of patients with cardiac surgery in Peru, as well as in other healthcare systems on the planet

REFERENCES

[1] Alvarez, A., Bagshaw, S., Biccard, B., Boccalatte, L., Borunda, D., Calvache, J. A., Carmona, M. J. C., Castillo-Huerta, N. M., Charles, S., & De-la Medina, A. R. (2025). Patient outcomes after surgery in 17 Latin American countries (LASOS): a 7-day prospective cohort study. The Lancet Global Health, 13(4), e635-e645.

[2] Carhuayo-Chura, J., Terpin-Ayvar, F. E., Bautista-Pariona, A., Zila-Velasque, J. P., Velarde-Zegarra, L. S., Davila-Aliaga, C., & Bravo-Jaimes, K. (2025). Short-Term Results of Early Detection of Critical Congenital Heart Disease: The Peruvian Maternal Perinatal Experience. JACC: Advances, 4(6_Part_1), 101775.

[3] Chacon-Diaz, M., Laymito Quispe, R., Hernandez-Vasquez, A., & Vargas-Fernandez, R. (2022). Study Protocol for the Peruvian Registry of Advanced Heart Failure (REPICAV). Frontiers in cardiovascular medicine, 9, 896821.

[4] Chen, Y., Freedman, N. D., Rodriguez, E. J., Shiels, M. S., Napoles, A. M., Withrow, D. R., Spillane, S., Sigel, B., Perez-Stable, E. J., & de González, A. B. (2020). Trends in premature deaths among adults in the United States and Latin America. JAMA Network Open, 3(2), e1921085-e1921085.

[5] Cheng, S. P., Heo, K., Joos, E., Vervoort, D., & Joharifard, S. (2024). Barriers to accessing congenital heart surgery in low-and middle-income countries: a systematic review. World Journal for Pediatric and Congenital Heart Surgery, 15(1), 94-103.

[6] Cubas, W. S., Dongo-Minaya, W., Albán-Sánchez, F., Torres-Neyra, J., Paredes-Temoche, A., Inga-Moya, K., Bedoya-Copello, H., Luna-Victoria, W., & Velarde-Revilla, E. (2024). Survival and Mid-Term Outcomes of On-Pump vs. Off-Pump Coronary Artery Bypass Grafting: A Propensity Score-Matched Analysis in A First Peruvian Registry. Brazilian Journal of Cardiovascular Surgery, 39, e20230242.

[7] Cubas, W. S., Hernandez, M., Cubas, S., Vota, C. S., Montero, J. A., Soca, G., & Dayan, V. (2025). Latin America's Cardiovascular Scientific Surgeons: A 20-Year Visual and Bibliometric Journey of Resilience. Annals of Thoracic Surgery Short Reports.

[8] Cubas, W. S., Vásquez-Arias, J., Cáceres-Farfán, L., Moreno-Loaiza, M., Pachas-Canales, C., & Velarde-Revilla, E. (2020). Modified bentall and de bono surgery: Experience in a national hospital of Peru. International Journal of the Cardiovascular Academy, 6(3), 129-129.

[9] Cuevas, C., Kikushima-Alcantara, P., & Miranda, J. J. (2025). The State of Cardiovascular Care in Peru: Needs for System Strengthening. Circulation, 152(1), 7-10.

[10] Diaz-Arocutipa, C., Salguero-Bodes, R., Juárez, V., Martín-Asenjo, R., Valenzuela-Rodriguez, G., Torres-Valencia, J., Navarro, P. R., Pariona, M., & Vicent, L. (2025). National Trends in Heart Failure Admission in Peru: Insights into Regional and Demographic Disparities from 2018 to 2023. Current Problems in Cardiology, 102985.

[11] Duarte, F. R., Silvera, K. M., Hernandez, A. D., Herrera, D. L., Parra, V. P., Parra, S. P., Parra, A. P., & Gutierrez, J. O. (2024). PP365 Topic: AS12–Heart: Heart Failure/Transplantation/Cardiopulmonary Bypass/Cardiac Surgery/Other: EFFECTIVENESS OF HYPOXIC GAS THERAPY IN THE PREOPERATIVE MANAGEMENT OF CONGENITAL HEART DISEASES WITH PULMONARY OVERFLOW: A SYSTEMATIC REVIEW. Pediatric Critical Care Medicine, 25(11S), e114-e115.

[12] Figueroa-Alfaro, C., Freyre-Ríos, H., & Barrantes-Alarcón, C. (2023a). Follow-up of the aortic valve replacement surgery in a national reference hospital in Lima, Peru, period 2016-2019. Acta Médica Peruana, 40(1), 24-30.

[13] Figueroa-Alfaro, C., Freyre-Ríos, H., & Barrantes-Alarcón, C. (2023b). Seguimiento de la cirugía de reemplazo valvular aórtico en un hospital de referencia nacional en Lima-Perú, periodo 2016-2019. Acta Médica Peruana, 40(1), 24-30.

[14] Francis, J., Peng, E., & Corno, A. F. (2024). Beyond borders: an appraisal of the global congenital cardiac surgery workforce. Translational Pediatrics, 13(6), 897.

[15] Gálvez-Caballero, D., Huaringa-Marcelo, J., Conde-Vela, C., Alarcón-Ruiz, C. A., Fernández-Chinguel, J. E., Taype-Rondan, A., Dyck-Arbulú, H. v., Espinoza-Rivas, G. M., Morón-Castro, J. A., & Ortega-Díaz, J. L. (2019). Clinical practice guideline for the evaluation and management of patients with severe aortic stenosis for the Peruvian Social Security. Archivos de cardiología de México, 89(1), 58-73.

[16] Guevara Rodríguez, D. M., Pichihua Grandez, J. D., Dianderas, F. V., & Del Carmen Sara, J. (2025). Incidence of cerebrovascular disease in Peru from 2015 to 2023. PLOS Global Public Health, 5(5), e0004559.

[17] Kadri, A. N., Wilner, B., Hernandez, A. V., Nakhoul, G., Chahine, J., Griffin, B., Pettersson, G., Grimm, R., Navia, J., & Gordon, S. (2019). Geographic trends, patient characteristics, and outcomes of infective endocarditis associated with drug abuse in the United States from 2002 to 2016. Journal of the American Heart Association, 8(19), e012969.

[18] Mejia, O. A., Lisboa, L. A. F., Caneo, L. F., Arita, E. T., Brandão, C. M. d. A., Dias, R. R., Costa, R., Jatene, M. B., Pomerantzeff, P. M. A., & Dallan, L. A. O. (2020). Analysis of> 100,000 cardiovascular surgeries performed at the heart institute and a new era of outcomes. Arquivos Brasileiros de Cardiologia, 114(4), 603-612.

[19] Menacho, K. D., Ramirez, S., Perez, A., Dragonetti, L., Perez de Arenaza, D., Katekaru, D., Illatopa, V., Munive, S., Rodriguez, B., & Shimabukuro, A. (2022). Improving cardiovascular magnetic resonance access in low-and middle-income countries for cardiomyopathy assessment: rapid cardiovascular magnetic resonance. European Heart Journal, 43(26), 2496-2507.

[20] Moya-Salazar, J., Marín, E. A., Palomino-Leyva, C. B., Rivera, J., Torre, R. L., Cañari, B., Pardo-Villarroel, C., & Contreras-Pulache, H. (2024). Geospatial analysis of cardiovascular mortality before and during the COVID-19 pandemic in Peru: analysis of the national death registry to support emergency management in Peru. Frontiers in cardiovascular medicine, 11, 1316192.

[21] Murala, J. S., Karl, T. R., & Pezzella, A. T. (2019). Pediatric cardiac surgery in low-and middle-income countries: present status and need for a paradigm shift. Frontiers in pediatrics, 7, 214.

[22] Peix, A., Mesquita, C. T., Gutiérrez, C., Puente, A., Dueñas-C, K. A., Massardo, T., Berrocal, I., Astesiano, A., Agüero, R. N., & Bañolas, R. (2022). Current status of nuclear cardiology practice in Latin America and the Caribbean, in the era of multimodality cardiac imaging approach: 2022 update. Nuclear Medicine Communications, 43(12), 1163-1170.

[23] Pinto-Salinas, M., Morón-Castro, J., Chavarri-Velarde, F., Soplopuco-Palacios, F., Palma-Ortecho, L., & Lescano-Alva, M. (2022). Heart transplantation at the Peruvian National Heart Institute: One-decade single-center experience. Journal of Cardiac Surgery, 37(6), 1550-1558.

[24] Polo-Gutierrez, G., Silva-Tejada, H. A., Martinez-Ninanqui, F. W., Robles-Velarde, V., & Ríos-Ortega, J. (2023a). Análisis de las cirugías cardíacas y mortalidad operatoria en el Instituto Nacional Cardiovascular durante el 2022. Archivos peruanos de cardiología y cirugía cardiovascular, 4(2), 55-61.

[25] Polo-Gutierrez, G., Silva-Tejada, H. A., Martinez-Ninanqui, F. W., Robles-Velarde, V., & Ríos-Ortega, J. (2023b). Analysis of cardiac surgeries and operative mortality at the National Cardiovascular Institute during 2022. Archivos peruanos de cardiología y cirugía cardiovascular, 4(2), 55-61.

[26] Quezada-Pinedo, H. G., Ahanchi, N. S., Cajachagua-Torres, K. N., Obeso-Manrique, J. A., Huicho, L., Gräni, C., & Muka, T. (2023). A comprehensive analysis of cardiovascular mortality trends in Peru from 2017 to 2022: Insights from 183,386 deaths of the national death registry. American Heart Journal Plus: Cardiology Research and Practice, 35, 100335.

[27] Rahman, S., Zheleva, B., Cherian, K., Christenson, J. T., Doherty, K. E., De Ferranti, D., Gauvreau, K., Hickey, P. A., Kumar, R. K., & Kupiec, J. K. (2019). Linking World Bank development indicators and outcomes of congenital heart surgery in low and middle-income countries: retrospective analysis of quality improvement data. BMJ open, 9(6), e028307.

[28] Rebolledo, M. A., Kumar, T. S., Tansey, J. B., Pickens, B., Allen, J., Hanafin, H. J., Boston, U. S., & Knott-Craig, C. J. (2020). Single institution experience with international referrals for pediatric cardiac surgery. World Journal for Pediatric and Congenital Heart Surgery, 11(6), 727-732.

[29] Rios-Blancas, M. J., Pando-Robles, V., Razo, C., Carcamo, C. P., Mendoza, W., Pacheco-Barrios, K., Miranda, J. J., Lansingh, V. C., Demie, T. G., & Saha, M. (2023). Estimating mortality and disability in Peru before the COVID-19 pandemic: a systematic analysis from the Global Burden of Disease Study 2019. Frontiers in public health, 11, 1189861.

[30] Ríos-Ortega, J. C., Aranda-Pretell, N., Talledo-Paredes, L., Davila-Durand, M., Reyes-Torres, A., Pérez-Valverde, Y., & Morón-Castro, J. (2022). Aortic valve reconstruction surgery. Operative results from a Peruvian Cohort Running title: AVrec Surgery. Authorea Preprints.

[31] Ríos-Ortega, J. C., Sisniegas-Razón, J., Conde-Moncada, R., Pérez-Valverde, Y., & Morón-Castro, J. (2022). Aortic valve replacement through minithoracotomy. Results from the Peruvian experience. Archivos peruanos de cardiología y cirugía cardiovascular, 3(2), 69.

[32] Riva, J., Calviño, J., Bouchacourt, J. P., Turconi, L., Cavalleri, F., Caetano, N. N., Enriquez, L., Tonelotto, B., Lema, G., & Motta, P. (2024). Heterogeneity Among Countries in the Subspecialty of Cardiovascular Anesthesia in Latin America: Survey Results. Journal of Cardiothoracic and Vascular Anesthesia, 38(2), 371-378.

[33] Rivera, E. W. S., Silva-Delgado, L., Espiche, C., Larco, P., Jauregui, A., & Mendoza-Quispe, D. (2024). PP366 Topic: AS12–Heart: Heart Failure/Transplantation/Cardiopulmonary Bypass/Cardiac Surgery/Other: FACTORS ASSOCIATED WITH PROLONGED MECHANICAL VENTILATION IN PEDIATRIC PATIENTS UNDERGOING CARDIOPULMONARY BYPASS SURGERY: A SINGLE-CENTER COHORT STUDY IN PERU. Pediatric Critical Care Medicine, 25(11S), e115.

[34] Rojel, U., Diaz, J. C., de Oliveira Figueiredo, M. J., Di Biase, L., Saad, E., Aguinaga-Arrascue, L., Cueto, F., Diez, J. C. L., Torres-Molina, R., & Pisani, C. F. (2025). Current state of arrhythmia care in Latin America: A statement from the Latin American Heart Rhythm Society. Heart Rhythm O2, 6(1), 112-126.

[35] Ruiz-Beltrán, A. M., Chacón-Loyola, G., Barajas-Campos, R. L., Alcaraz-Guzmán, A., Montoya-Hernández, M. A., Alcázar-Flores, L. D., & Rodríguez-Chávez, L. L. (2025a). Performance of scoring systems for predicting mortality after cardiac surgery in the elderly. Archivos peruanos de cardiología y cirugía cardiovascular, 6(1), 29-35.

[36] Ruiz-Beltrán, A. M., Chacón-Loyola, G., Barajas-Campos, R. L., Alcaraz-Guzmán, A., Montoya-Hernández, M. A., Alcázar-Flores, L. D., & Rodríguez-Chávez, L. L. (2025b). Rendimiento de los sistemas de puntuación para predecir mortalidad después de cirugía cardíaca en adultos mayores. Archivos peruanos de cardiología y cirugía cardiovascular, 6(1), 29-35.

[37] Sanchez, J. B., Alcalde, J. D. C., Isidro, R. R., Luna, C. Z., Cubas, W. S., Charres, A. C., Gutierrez, J. E., Ochoa, J. D., & Arias, P. F. (2021). Acute limb ischemia in a Peruvian cohort infected by COVID-19. Annals of Vascular Surgery, 72, 196-204.

[38] Shah, S. R., Bibi, A., Ririe, A. K., & Phuc, V. H. (2025). CHARACTERIZING CARDIAC SURGERIES AND MORTALITY ASSESSMENT AT A NATIONAL CARDIOVASCULAR INSTITUTE, PERU, SOUTH AMERICA. Journal of Medical & Health Sciences Review, 2(1).

[39] Silva-Delgado, L., Jauregui, A., Espiche, C., Larco, P., Mendoza-Quispe, D., & Rivera, E. W. S. (2024). PP368 Topic: AS12–Heart: Heart Failure/Transplantation/Cardiopulmonary Bypass/Cardiac Surgery/Other: LONG-TERM SURVIVAL FOR POSTOPERATIVE COMPLICATIONS AFTER PEDIATRIC CARDIAC SURGERY IN PERU: 20-YEAR REGISTRY. Pediatric Critical Care Medicine, 25(11S), e115.

[40] Silva-Delgado, L. E., Jáuregui-Farfán, A., Espiche-Salazar, C., Larco-Castilla, P., Dávalos-Quevedo, R. d. P., Silva-Delgado, K. M., & Silva-Rivera, E. W. (2024). Long-term survival of patients with postoperative complications in cardiac surgery: Experience of a specialized pediatric institute in Peru, 2001-2019. Rev. pediatr. espec, 165-174.

[41] Silva-Tejada, H., Sisniegas-Razón, J., Martínez-Ninanqui, F., Díaz-Chávez, Z., & Ríos-Ortega, J. C. (2025). Morbimortalidad perioperatoria de las cirugías cardíacas en el Instituto Nacional Cardiovascular, Lima, Perú, durante el año 2023. Archivos peruanos de cardiología y cirugía cardiovascular, 6(1), 36-43.

[42] Silva Delgado, L. E., Vasquez Cueva, E. T., Silva Delgado, K., Maguiña Quispe, J. L., & Silva, E. (2025). Long-term outcomes after pediatric cardiac surgery: A 20-year single-institution study. Perfusion, 02676591251328926.

[43] Silva Rivera, E. W. (2022). Factores de riesgo asociados a la sobrevida de los pacientes sometidos a cirugía cardiovascular con circulación extracorpórea en un hospital pediátrico peruano. Rev. pediatr. espec, 40-48.

[44] Tauma-Arrué, A., Chávez-Saldivar, S., Mego, J. C., Luis-Ybáñez, O., Coronado-Quispe, J., Lucena, S., Alvarez, C., Melgar, E., Morales, A., & Marquez, R. (2022). Trends in outpatient visits and deaths due to congenital heart defects in Peru. International Journal of Cardiology Congenital Heart Disease, 7, 100334.

[45] Tchervenkov, C. I., Herbst, C., Jacobs, J. P., Al-Halees, Z., Edwin, F., Dearani, J. A., Finucane, K., Sandoval, N., Sarris, G. E., & Fragata, J. (2021). Current status of training and certification for congenital heart surgery around the world: proceedings of the meetings of the global council on education for congenital heart surgery of the world society for pediatric and congenital heart surgery. World Journal for Pediatric and Congenital Heart Surgery, 12(3), 394-405.

[46] Terry, F., Enríquez-Marulanda, A., Chinchihualpa-Paredes, N., Carbajal-Galarza, M., Vidal-Cuellar, C. L., Mas-Ubillus, G., Diaz-Llanes, B., Quispe-Vicuña, C., Pacheco-Barrios, N., & Arbulu-Zuazo, R. (2025).

Clinical Predictors of Inpatient Mortality and Poor Postoperative Course After aSAH Microsurgical Clipping: A 10-Year Experience from a Peruvian Tertiary Care Center. Journal of Clinical Medicine, 14(13), 4799.

[47] Tsao, C. W., Aday, A. W., Almarzooq, Z. I., Anderson, C. A., Arora, P., Avery, C. L., Baker-Smith, C. M., Beaton, A. Z., Boehme, A. K., & Buxton, A. E. (2023). Heart disease and stroke statistics—2023 update: a report from the American Heart Association. Circulation, 147(8), e93-e621.

[48] Vázquez-Troche, J. A., García-Fernández, V., Hernández-Vásquez, A., Vargas-Fernández, R., & Bendezu-Quispe, G. (2022). Trends in mortality from ischemic heart disease in Peru, 2005 to 2017. International Journal of Environmental Research and Public Health, 19(12), 7047.

[49] Vera-Ponce, V. J., Zuzunaga-Montoya, F. E., Vásquez-Romero, L. E. M., Loayza-Castro, J. A., De Carrillo, C. G., & Vigil-Ventura, E. (2025). Prevalence, trends, and associated factors of isolated systolic, diastolic, and systolic–diastolic hypertension in Peru: A nine-year analysis of the Demographic and Family Health Survey. Hipertensión y Riesgo Vascular, 42(1), 18-28.

[50] Vervoort, D., Meuris, B., Meyns, B., & Verbrugghe, P. (2020). Global cardiac surgery: access to cardiac surgical care around the world. The Journal of thoracic and cardiovascular surgery, 159(3), 987-996. e986.