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Original Article

# Body Composition Analysis in Young Pakistani Adults with Stable Ischemic Heart Disease versus Acute Coronary Syndrome

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## ABSTRACT

***Objective***: To analyze the mean difference in total body composition on Bioelectrical Impedance Analyzer (fat percentage, lean body mass, visceral fat area, and segmental fat/muscle distribution) between young adults with SIHD and ACS.
***Study Design***: Comparative cross-sectional study.
***Place and Duration of Study***: Armed Forces Institute of Cardiology/National Institute of Heart Diseases, Rawalpindi Pakistan, from Aug to Nov 2025.
***Methodology***: Two hundred patients (males aged 18–45 years and females aged 18–50 years) were enrolled using non-probability convenience sampling. Patients with acute illness, inflammatory conditions, or uncontrolled endocrine disorders affecting body composition were excluded. Participants were categorized into ACS-Group and SIHD-Group. Body composition was assessed using the InBody 270 analyzer in the upright position, with measurements performed in the morning after an overnight fast.
***Results***: Among the 200 study participants, the ACS-Group (n=100) had a slightly higher median age [38.0 (32.0–44.0) years] than the SIHD-Group [34.0 (29.5–42.0) years, *p*-value =0.05]. However, ACS patients demonstrated a higher heart rate (92.08±14.61 vs. 78.96±12.46 bpm), greater skeletal muscle mass [38.08 (36.43–39.92) vs. 29.52 (28.04–31.12) kg], higher lean body mass [57.77 (56.21–59.66) vs. 49.29 (47.71–51.59) kg], and an elevated waist-to-hip ratio (0.93±0.09 vs. 0.902±0.09) compared with the SIHD-Group.
***Conclusion***: Body composition parameters and lipid abnormalities contribute to early-onset coronary artery disease, with distinct patterns in ACS and SIHD. Incorporating body composition assessment into conventional risk evaluation may enhance risk stratification and support targeted prevention in high-risk young individuals.

**Keywords**: Acute Coronary Syndrome, Body Composition, Stable Ischemic Heart Disease.

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## INTRODUCTION

Stable Ischemic Heart Disease (SIHD) and Acute Coronary Syndrome (ACS) are major clinical manifestations of coronary artery disease (CAD) and remain leading causes of morbidity and mortality globally and in Pakistan. In 2021, ischemic heart disease accounted for approximately 254 million prevalent cases and nearly 9 million deaths worldwide, highlighting its substantial public health burden.[1] In Pakistan, cardiovascular disease is a leading contributor to mortality and disability. Population-based studies report that 26.9% of middle-aged adults in urban Pakistan have underlying CAD, indicating a high national prevalence.[2] Additionally, the age-standardized incidence of cardiovascular disease was 918 per 100,000 population in 2019, exceeding global estimates.[3]

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ACS, the acute manifestation of CAD, poses a substantial burden in Pakistan, with 33%–37% of chest pain patients diagnosed with ACS in hospital-based studies, highlighting frequent acute coronary events.[4,5] These findings emphasize the urgent need for improved risk stratification and preventive strategies within the Pakistani population.

Both SIHD and ACS are closely linked to established risk factors, including hypertension, diabetes, dyslipidemia, smoking, and obesity. Emerging evidence indicates that visceral adiposity independently increases cardiovascular risk, with a high Visceral Adiposity Index (VAI) associated with a 55% higher risk of cardiovascular disease and a 38% increase in cardiovascular mortality, mediated through inflammation, insulin resistance, and accelerated atherosclerosis.[6]

Conventional measures such as Body Mass Index (BMI) are limited in their ability to characterize fat distribution and muscle mass.[8] In contrast,

bioelectrical impedance analysis using devices such as the InBody 270 Body Composition Analyzer allows detailed assessment of fat mass, lean mass, and visceral fat, with excellent reliability (ICC ≥0.98).[7] Given the rising incidence of ACS in younger individuals and the role of body composition in early disease pathogenesis,[8] Conventional measures like BMI inadequately assess fat distribution and muscle mass. Bioelectrical impedance analysis provides reliable evaluation of visceral fat, lean mass, and overall body composition. With rising incidence of ACS in younger populations, detailed body composition assessment may improve cardiovascular risk stratification. This study aims to determine these associations in young SIHD and ACS patients.

## METHODOLOGY

This comparative cross-sectional study was conducted at the Armed Forces Institute of Cardiology, Rawalpindi Pakistan; over a six-month period following approval of the study synopsis. Ethical approval was obtained from the Institutional Ethical Review Board (IERB#: 5/25; Synopsis Ref#: S/209/2025; Dated: 30th April 2025) of AFIC/NIHD. Participants were enrolled using a non-probability convenient sampling technique. The calculated sample was 100 for each group, on WHO sample size calculator. Total sample size n=200. Sampling was performed with significance level of 0.05, power of study 80%, percentage body fat in SIHD and ACS patients as 30.24±6.84% and 32.81±5.82% respectively,[9] was considered.

**Inclusion Criteria**: Eligible participants included male patients aged 18 to 45 years and female patients aged 18 to 50 years who were physically able to stand upright and remain still during body composition analysis using the InBody 270 Bioelectrical Impedance Analyzer (BIA).

**Exclusion Criteria**: Patients were excluded if they had an acute illness at the time of measurement, a history of acute or chronic inflammatory diseases, recent or active malignancy, severe renal or hepatic dysfunction, or uncontrolled endocrine disorders that could influence body composition. Additional exclusion criteria included pregnancy, lactation, recent bariatric surgery or significant weight loss, use of medications that alter body composition (e.g., corticosteroids or anti-diabetics), presence of implanted electronic medical devices, and any condition impairing the ability to undergo BIA measurements.


**Figure-1: InBody 270 Portable Device (Picture taken from inbodyusa.com)**

The diagnosis of SIHD was established through clinical evaluation of symptoms and risk factors, followed by a Pre-Test Probability (PTP) approach. All participants underwent a structured pre-procedural assessment, including detailed documentation of demographic data, clinical presentation, comorbidities, family history, lifestyle factors, and medication use. Standard laboratory investigations included lipid profile and cardiac biomarkers. The central component of this study was body composition assessment using the InBody 270 Bioelectrical Impedance Analyzer which uses impedance to measure and no statistic required, it takes 15 seconds to give the results. The InBody 270 delivers professional-grade body composition analysis in a portable design (Figure-1). It provides essential measurements including Percent Body Fat Skeletal Muscle Mass, and Whole Body Phase Angle with the accuracy you expect from InBody. Measurements were conducted in the morning following an overnight fast to ensure consistency. Parameters including skeletal muscle mass, BMR (Basic Metabolic Rate; minimum calories required by body at complete rest), Percent Body Fat (percent of weight of total body fat), Visceral Fat Level (fat tissue that is surrounded around the

internal organs; it is more dangerous), Muscle Mass (Mass of muscles that are attached to bones), Waist-Hip ratio (Measure of Fat distribution) and compared between the SIHD-Group and ACS-Groups. The data was distributed normally between the each group. All participants provided informed consent prior to enrollment.

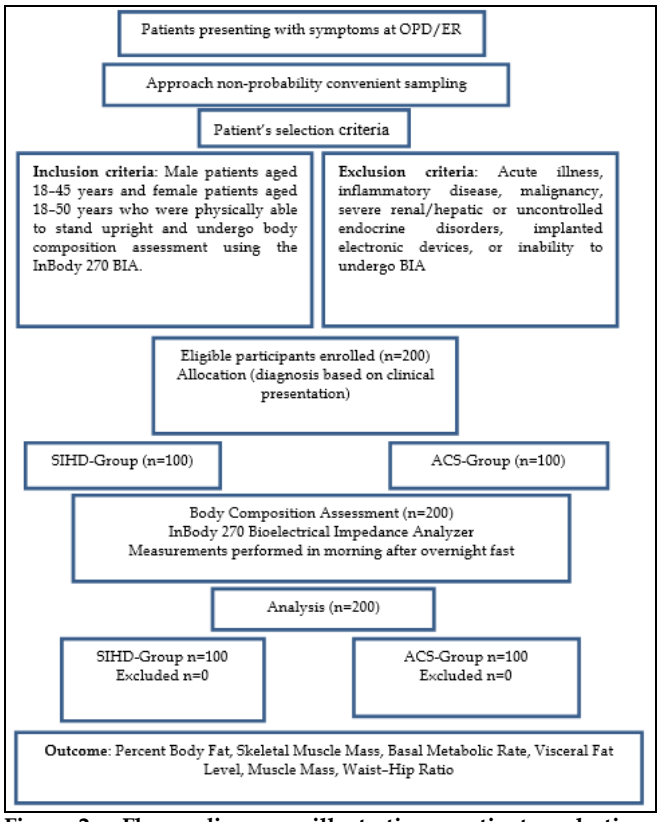


**Figure-2: Flow diagram illustrating patient selection, grouping, and analysis of study participants**

Data were analyzed using the Statistical Package for Social Sciences (SPSS), version 23. Normality of continuous variables was assessed using the Shapiro–Wilk test. Normally distributed variables (heart rate, percentage body fat, and muscle mass) were expressed as mean ± standard deviation (SD), whereas non-normally distributed variables (age, body mass index, and CAD severity) were presented as median with interquartile range (IQR). Categorical variables (gender and chest pain characteristics) were reported as frequencies and percentages. Comparisons of continuous variables between groups were performed using the independent samples t-test for normally distributed data and the Mann–Whitney U test for non-normally distributed data. Associations between categorical variables were assessed using the Chi-square test. A *p*-value <0.05 was considered statistically significant.

## RESULTS

Among the 200 study participants, the ACS-Group (n=100) had a slightly higher median age [38.0 (32.0–44.0) years] than the SIHD-Group [34.0 (29.5–42.0) years, *p*-value =0.05]. ACS patients had a significantly higher mean heart rate (92.1±14.6 vs 79.0±12.5 bpm, *p*-value <0.001). Gender distribution, BMI, chest pain characteristics, vessel involvement, and stenosis location were similar between ACS and SIHD patients. Overall, ACS patients demonstrated higher cardiac stress markers and disease severity, whereas other demographic and clinical features were similar across groups, Table-I.

**Table-I: Comparison of Baseline characteristics between Acute Coronary Syndrome and Stable Ischemic Heart Disease Patients (n=200)**

| Variables | | ACS-Group (n=100) | SIHD-Group (n=100) | *p*-value |
|---|---|---|---|---|
| | | Median (IQR) | | |
| Age(years) | | 38.0 (32.0–44.0) | 34.0 (29.5–42.0) | 0.05 |
| BMI (kg/m²) | | 27.5 (23.6–29.8) | 26.7 (24.2–28.2) | 0.50 |
| Heart Rate (bpm) (Mean+SD) | | 92.1+14.6 | 78.9+12.5 | <0.001* |
| | | Percentage | | |
| **Gender** | Male | 53.0 | 40.0 | 0.06 |
| | Female | 47.0 | 60.0 | |
| **Chest Pain Description** | Tightness | 25.0 | 26.0 | 0.64 |
| | Sharp Pain | 23.0 | 30.0 | |
| | Burning | 20.0 | 16.0 | |
| | Pressure | 32.0 | 28.0 | |
| **Vessels Involved** | Single | 40.0 | 26.0 | 0.07 |
| | Double | 28.0 | 40.0 | |
| | Triple | 32.0 | 34.0 | |

*ACS=Acute coronary Syndrome, SIHD = Stable Ischemic Heart Disease, BMI= Body Mass Index, * show the significant association i.e. p-value <0.05*

**Table-II: Comparison of Lipid Profile Parameters between Acute Coronary Syndrome and Stable Ischemic Heart Disease Patients (n=200)**

| Variables | ACS-Group (n=100) | SIHD-Group (n=100) | *p*-value |
|---|---|---|---|
| | Median (IQR) | | |
| Total Cholesterol (mg/dL) | 236.0 (204.0–270.0) | 231.0 (180.0–261.0) | 0.01* |
| LDL Cholesterol (mg/dL) | 145.0 (125.0–172.0) | 126.0 (104.0–151.0) | <0.001* |
| HDL Cholesterol (mg/dL) | 42.0 (32.0–48.0) | 46.0 (37.0–55.0) | <0.001* |
| Triglycerides (mg/dL) | 246.0 (181.0–289.0) | 215.0 (156.0–263.0) | <0.001* |

*ACS =Acute Coronary Syndrome, SIHD = Stable Ischemic Heart Disease, HDL= High Density Lipids, LDL=Low density lipids, * show the significant association i.e. p-value <0.05*

Lipid abnormalities were more pronounced in ACS patients, who had higher total cholesterol Median and IQR (236.0 [204.0–270.0] vs. 231.0 [180.0–261.0] mg/dL), LDL cholesterol (145.0 [125.0–172.0] vs. 126.0 [104.0–151.0] mg/dL), and triglycerides (246.0 [181.0–289.0] vs. 215.0 [156.0–263.0] mg/dL), but lower HDL cholesterol (42.0 [32.0–48.0] vs. 46.0 [37.0–

55.0] mg/dL) compared with SIHD patients, as summarized in Table-II. These differences were statistically significant for all parameters ($p \leq 0.01$).

In Table-III given below, in the Muscle-Fat Analysis, ACS patients had significantly higher skeletal muscle mass [38.1 (36.4–39.9) kg vs. 29.5 (28.0–31.1) kg, *p*-value <0.001] and lean body mass [57.7 (56.2–59.6) kg vs. 49.2 (47.7–51.5) kg, *p*-value <0.001] compared with SIHD patients. Basal metabolic rate was similar between groups [1606 (1373–1902) vs. 1617 (1412–1815) kcal, *p*-value =0.99], indicating comparable overall energy expenditure.

**Table-III: Body Composition Characteristics in Patients with Acute Coronary Syndrome and Stable Ischemic Heart Disease (n=200)**

| Variables | | ACS-Group (n=100) | SIHD-Group (n=100) | *p*-value |
|---|---|---|---|---|
| | | Median (IQR) | | |
| Muscle-Fat Analysis | Basic Metabolic Rate (kcal) | 1606.0 (1373.0–1902.0) | 1617.0 (1412.0–1815.0) | 0.99 |
| | Skeletal Muscle Mass (kg) | 38.1 (36.4–39.9) | 29.5 (28.0–31.1) | <0.001* |
| | Lean Body Mass (kg) | 57.7 (56.2–59.6) | 49.3 (47.7–51.5) | <0.001* |
| | | Mean+SD | | |
| Obesity Analysis | BMI (kg/m²) | 26.7±4.4 | 26.4±4.0 | 0.63 |
| | Percent Body Fat (%) | 28.6±7.0 | 26.1±5.7 | <0.001* |
| | Muscle Mass (kg) | 20.7±6.4 | 23.6±4.1 | <0.001* |
| | Waist-Hip Ratio | 0.9±0.1 | 0.9±0.1 | 0.01* |
| | Visceral Fat Level | 14.8±4.0 | 12.4±3.6 | <0.001* |

*ACS =Acute Coronary Syndrome, SIHD = Stable Ischemic Heart Disease, * show the significant association i.e. p-value <0.05*

In the Obesity Analysis, no significant difference in BMI was observed between ACS and SIHD patients (26.7±4.4 vs. 26.4±4.0 kg/m²; *p*-value =0.63) within the normal to overweight range according to InBody 270 reference values. ACS patients exhibited higher percent body fat (28.6±7.0% vs. 26.1±5.7%, *p*-value <0.001), waist-to-hip ratio (0.9±0.1 vs. 0.9±0.1, *p*-value =0.01), and visceral fat level (14.8±4.0 vs. 12.4±3.6, *p*-value <0.001), indicating increased central and visceral adiposity, which are established cardiovascular risk factors. Interestingly, total muscle mass was higher in SIHD patients (23.6±4.1 kg vs. 20.7±6.4 kg, *p*-value <0.001), suggesting differences in muscle distribution between groups.

ACS patients skeletal and lean muscle mass were within the normal range, but visceral fat (14.8±4.0), body fat percentage (28.6±7.0), and waist-to-hip ratio (0.9±0.1) were elevated, indicating higher cardio-vascular risk. SIHD patients had relatively lower skeletal and lean mass but slightly better fat distribution, reflected by lower visceral fat levels (12.4±3.6) and waist-to-hip ratio (0.9±0.1).

## DISCUSSION

This study provides insight into the role of body composition and lipid abnormalities in ACS and SIHD among young Pakistani adults. While traditional risk factors such as hypertension, diabetes, and obesity are well recognized, our findings suggest that differences in fat distribution, lean mass, and lipid profiles may play a more significant role in the early development of these conditions.

ACS patients had significantly higher visceral fat 14.8±4.0 ($p<0.001$), waist-to-hip ratio 0.9±0.1 ($p=0.015$), skeletal muscle mass 38.1 (36.4–39.9) ($p<0.001$), and lean body mass 57.7 (56.2–59.6) ($p<0.001$) compared with SIHD patients. Our study results suggest that body fat distribution i.e. visceral fat levels and waist to hip ratio, rather than overall body weight, may contribute to early ACS in young adults. These findings align with previous literature highlighting the detrimental effects of visceral adiposity, which can increase systemic inflammation up to tenfold, promote insulin resistance, and impair muscle glucose uptake and hepatic insulin sensitivity, as reviewed in prior studies. Excess free fatty acids from visceral fat may contribute to metabolic complications, including dyslipidemia and an increased risk of type 2 diabetes (T2DM),[10] as well as endothelial dysfunction that accelerates atherosclerosis and maintains residual cardiovascular risk.[11] Furthermore, recent studies using CT angiography have demonstrated a strong correlation ($r=0.22$, $p=0.007$) between visceral fat and both the burden and severity of coronary plaque ($r=0.25$, $p=0.002$), underscoring its potential role in precipitating acute coronary events.[12]

Lipid disorders were also more severe in ACS patients, who had lower HDL (40.6+8.7, *p*-value =0.013) and high total cholesterol (234.2+39.8, $p<0.001$) LDL (145.6+29.0, *p*-value=0.000) and triglycerides (236.1+63.9, *p*-value =0.004) than those with SIHD.[12] This tendency indicates an atherogenic lipid profile, which was repeatedly associated with poor cardiovascular prognosis. Recent registry data show,[13] dyslipidemic patients with ACS have a higher risk of adverse events and worse prognosis. In particular, patients familial hypercholesterolemia (FH) exhibited a 3-fold higher incidence of premature ACS compared with non-FH patients (hazard ratio 3.1; 95% CI 1.6–5.9; *p*-value <0.001), emphasizing the critical need for aggressive lipid management to reduce early cardiovascular risk.[14] In addition, residual risk caused by poor lipid profiles is a significant problem even in

the presence of guideline-directed therapy as shown in study of the Chinese database of cardiovascular diseases that follow up of patient (n=42,230), only 5.3% achieved the LDL-C target (< 1.4 mmol/L) at admission despite being ultra-high-risk, highlighting widespread suboptimal lipid control among ACS patients respectively.[15] Literature by reviews on the use of lipid-lowering strategies not only targeted on LDL but also other lipids enhances the application of intensive therapy after ACS to correct persistent atherogenic dyslipidemia.[15,16]

Our findings, in line with previous research, reinforce the growing evidence that visceral fat distribution and lipid abnormalities are key contributors to early-onset coronary artery disease, beyond traditional risk factors. Systematic reviews indicate that a higher abdominal visceral-to-subcutaneous fat (VAT-to-SAT) ratio is strongly associated with the development of cardiovascular disease ($p$-value <0.01).[17] Moreover, detailed lipid profiling may improve cardiovascular risk stratification in young adults, facilitating the identification of high-risk individuals and the implementation of targeted preventive measures. Supporting this, a Chinese cohort study classified lipid profiles into distinct patterns, with Profile 3 (low total cholesterol, LDL, and TyG, high HDL) comprising 18.9% of participants, and Profile 4 (highest total cholesterol, LDL, TyG, and HDL) comprising 3.4%, highlighting the clinical relevance of intensive lipid assessment.[18] Our study shows that there was no significant difference of BMI between both groups i.e. ACS and SIHD as shown by the previous literature that even though BMI is the independent predictor of Coronary Artery Disease but it often does not differentiate between the ACS and SIHD.[19]

## CONCLUSION

This study demonstrates that young adults with ACS and SIHD exhibit distinct patterns of body composition and lipid abnormalities. These findings in our study highlight the critical role of fat distribution, lean mass, and dyslipidemia in the early development of coronary artery disease. Incorporating body composition analysis alongside traditional cardiovascular risk assessment may enhance risk stratification and support targeted preventive strategies in this high-risk young population.

## LIMITATIONS OF THE STUDY

This study only included younger individuals. The data was taken from only hospital of Rawalpindi, thus it can reduce the generalizability to broader young individuals of Pakistan. The Body Composition analysis was done using BIA, a method influenced by hydration status. Several potential confounding variables such as dietary habits, physical activity levels, socioeconomic status, smoking, and family history were not fully controlled for, which may have influenced the observed differences between stable ischemic heart disease and acute coronary syndrome groups.

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**Authors' Contribution**

Following authors have made substantial contributions to the manuscript:

MN & AAC: Concept, study design, drafting the manuscript, approval of the final version to be published.

QZB & RA: Concept, data acquisition, critical review, approval of the final version to be published.

IH & TZ: Data acquisition, data analysis, data interpretation, approval of the final version to be published.

Authors agree to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.

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