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Correlation of Atherogenic Index of Plasma with Severity of Coronary Artery Disease in Patient with Non-ST Segment Elevation Acute Coronary Syndrome

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ABSTRACT

Background: Dyslipidemia is the main risk factor for Acute Coronary Syndrome (ACS). Atherogenic Index of Plasma (AIP) calculated as logarithm triglycerides/high-density lipoprotein cholesterol (TG/HDL-C) is a reflection of plasma atherogenicity. The aim of this study was to find out the correlation of Atherogenic Index of Plasma with coronary artery disease severity in Non ST segment Elevation Acute Coronary Syndrome(NSTE-ACS). **Methods:** This cross-sectional analytical study was conducted in the department of cardiology, National Heart Foundation Hospital and Research Institute from October, 2019 to August, 2020. Total 120 patients of NSTE-ACS who underwent coronary angiography included after considering inclusion and exclusion criteria, study population was divided into three groups according to AIP; Group I: AIP≤ 0.19 (n=41), Group II: AIP>0.19-0.32 (n=41), Group III: AIP>0.32 (n=38). Baseline characteristics, biochemical variables and coronary disease severity by Gensini score were then compared between the three groups. **Results:** Participants had a mean age of 56.05± 9.81 years with 81.7% men. AIP was significantly increased with increased Gensini score. There was positive correlation (r= 0.819) observed between AIP and Gensini score, which was statistically significant ($p<0.05$). Logistic regression analysis showed that AIP was independently associated with severity of coronary artery disease assessed by Gensini score (OR=26.662, $p<0.001$). **Conclusion**: Atherogenic Index of Plasma was an independent predictor of coronary artery disease severity in patients with Non ST segment Elevation Acute Coronary Syndrome.

Keywords: Atherogenic Index of Plasma; Gensini score; Non ST segment Elevation Acute Coronary Syndrome; Coronary Angiogram.

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INTRODUCTION

Coronary artery disease (CAD) is a global health problem reaching an epidemic proportion in both developed and developing countries. [1] There were an estimated 8.92 million deaths due to CAD in 2015 making CAD the leading cause of death in the world. [2] South Asians are unduly prone to develop CAD. Most notable features of CAD in this population are the extreme prematurity, clinically aggressive and angiographically extensive lesion. [3] The underlying pathophysiology is poorly understood. Genetic predisposition, ethnicity, high prevalence of metabolic syndrome and conventional risk factors, lifestyle related factors, including dietary habits, excess saturated and trans fat, high salt intake and low-level physical activity may play a role. [4] The prevalence of IHD perhaps was first reported in 1976, which was 0.33%. [5] A study was done among 853 patients in NICVD and National Heart Foundation Hospital in Dhaka and the reported prevalence are: hypertension (30%), heart failure (28.5%),

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myocardial infarction (20.9%), ischemic heart disease (19.9%), stroke (17.1%) and angina (11%). [6] Prevalence of CVD ranged from 0.062-77.7% in another study. [7] A study showed that prevalence rate of CAD in Bangladesh is 3.4% in rural population and 19.6% in urban population. [8] The clinical presentations of coronary artery disease include silent ischemia, stable angina pectoris, NSTE-ACS (UA and NSTEMI), STEMI, heart failure and sudden cardiac death. [9] In Bangladesh, ACS is the major presenting form of CAD and thus ACS management is the main challenge in Cardiac patient care. The ACS consists of STEMI, NSTE-ACS. NSTE-ACS again consist of Non- STEMI and UA. NSTE-ACS is usually associated with subtotal occlusion whereas STEMI is associated with complete occlusion of the involved vessel(s). [10] Again the distinction between UA and NSTEMI depends on the presence of myocardial infarction as determined by markers of myocardial damage such as TnI, TnT or CKMB. NSTE ACS is much more common than STEMI. In the United States, 1.4 million patients per year are admittedto hospital with ACS, approximately 70% with NSTE ACS. [11] By 6 months, NSTE ACS mortality rates may equal or exceed those of STEMI and by 12 months, rates of death, MI, and recurrent instability in contemporary registries are >10%. [12] Braunwald et al. (2002) [13] showed that among patient with NSTE ACS, approximately 15% experienced a reinfarction or death within 30 days of diagnosis; and in another study in hospital death was 6% in NSTEMI and 3% for unstable angina. [14] ACS is mainly caused by coronary atherosclerosis with or without luminal thrombosis and vasospasm. [15] Atherosclerosis is the main cause of coronary artery disease. There are many risk factor for atherosclerosis. Among them lipid profile of plasma is the major risk factors and predictor of CAD. [16] Dyslipidaemia is a group of conditions in which there are abnormal levels of lipids and lipo-proteinsin the blood. High LDL-C, high TG and low HDL-C have all been predictors for CAD risk. [17] Carbohydrate is themain diet of Bangladeshi people and high plasma concentration of TG and low plasma concentration of HDL C is consistent with the effects of high carbohydrate diet. [18] Moreover low HDL C and high TG are components of metabolic syndrome and pointer to insulin resistance. Insulin resistance and metabolic syndrome are more common in South Asian countries and thought to be very important risk factors for the increased prevalence of CAD in this region. [19] Many clinical studies make effort to introduce a better marker of atherogenic dyslipidemia that can predict the risk of CVD which will be useful for evaluating response to treatment as well. [20] It has been shown that AIP is a strong marker to predict the risk of atherosclerosis and coronary heart disease. [21] AIP defined as, a logarithmically transformed ratio of TGs to HDL-C. AIP=$\log_{10}$(TG/HDL C). [22] AIP Level; Low risk score:<0.11, intermediate score: 0.11 to 0.24 and high risk score is >0.24. [23] The AIP is a reflection of the degree of plasma atherogenicity. The AIP is proposed as a marker of plasma atherogenicity as its value increases in individuals with a high risk of CAD occurrence. [24] Epidemiological studies suggested that AIP was significantly associated with obesity, EH, DM and other risk factors for CAD. [25] In recent years, AIP was identified as the superior predictor ofCAD and cardiovascular events. [26] Dobiasova et al. (2011) [27] obtaining AIP is a predictor of cardiovascular disease risk and therapeutic effectiveness. Bhardwaj et al. (2013) [28] studied 60 patients with coronary artery disease as evidenced by coronary angiography compared with controls, obtaining AIP significantly predicted coronary artery disease. The AIP correlates well with LDL particle size and may be an indicator of the atherogenic lipoprotein phenotype. The AIP is a sdLDL indicator. Small dense LDLis a small and dense LDL particle, which is proatherogenic in that it has the greater atherogenic ability because it is susceptible to oxidation, to promote formation of foam cells and LDL C with oxidized Apo protein B. Also they can cause atherosclerosis by increasing lipid peroxidation, activating oxygen radicals, expressing adhesion molecules on endothelial cells which were linked to endothelial dysfunction high sdLDL concentrationscorrelated with CAD risk 3-7 times, regardless of LDL cholesterol levels in circulation. [29] Examination of sdLDL is expensive and uses complex procedures such as ultracentrifugation, electrophoresis, and nuclear magnetic resonance. This limits the use of sdLDL as a risk factor for cardiovascular disease. So AIP measurement is cost effective, easily measured and commercially available. [30]

OBJECTIVE

General Objective:

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To evaluate the association of atherogenic index of plasma with extent of coronary artery disease in patients with NSTE ACS undergoing coronary angiogram.

Specific Objectives:

- To measure atherogenic index of plasma among the study population.
- To determine angiographic extent of coronary artery disease by calculating Gensini score
- To determine correlation between atherogenic index of plasma with extent of coronary artery disease assessed by Gensini score.

METHODOLOGY

This study was a cross-sectional analytical study. The patients were selected by using purposive sampling method. The study was carried out from October, 2019 to August, 2020 in the Department of Cardiology, National Heart Foundation Hospital and Research Institute, Mirpur, Dhaka. Bangladesh. A total of 120 patients of both sexes were included in the study.

Inclusion Criteria:

Patient with NSTE ACS who underwent coronary angiography within study period.

Exclusion Criteria:

- <18 year's old
- History of prior CABG
- History of prior PCI
- Patient who received CPR before admission or any other recent trauma
- History of CCF and/or the presence of overt pump failure on admission
- Cardiogenic shock
- Patient with a history of dyslipidemia treatment
- Presence of valvular heart diseases
- Presence of advanced renal disease (serum creatinine >2mg/dl)
- Presence of advance hepatic disease

Study Procedure

A total of 120 patients who were admitted in the Department of Cardiology, NHFH & RI, Dhaka, with NSTE ACS fulfilling the inclusion and exclusion criteria were enrolled for the study. Informed written consent was taken from each patient before enrollment. Meticulous history was taken and detailed clinical examination was performed and recorded in predesigned structured data sheet. Risk factors profile including smoking, hypertension, diabetes, family history of coronaryartery disease and BMI had been noted. ECG: 12 lead resting ECG was done at a paper speed of 25 mm/s and 10 mmstandardization at admission. Laboratory investigations had been done: Serum Troponin I, fasting lipid profile, Serum creatinine, Random Blood Sugar, Serum Troponin I concentration was determined by immunometric assay at the time ofadmission but not before 6 hours from the onset of chest pain. The level of troponin I $\geq$ 0.6 ng/ml was considered as positive cardiac marker. CAG was performed and Gensini score was calculated. AIP was calculated from fasting lipid profile

Data Analysis

Data were analyzed by SPSS version 16.0. Obtained data had been expressed in frequency, percentage, mean and standard deviation as applicable. Comparison between groups had been done by Student's T-test for continuous variables. Categorical data had been compared by chi-square test. P-value of <0.05 had been considered as significant. Correlation between AIP and coronary artery diseaseseverity by Gensini score had been done and

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plotted by scattered plot. Logistic regression was also performed for association of AIP with Gensini score after adjusting for other confounding factors.

Ethical Clearance

The study approved by the Ethical Review Committee of National Heart Foundation Hospital and Research Institute, Mirpur, Dhaka. Bangladesh.

RESULTS

Total 120 NSTE-ACS patients were included in the study. They were divided into three groups on the basis of AIP. In Group I (AIP, ≤0.19): 41 Patients, in group II (AIP, >0.19-0.32): 41 Patients and in Group III (AIP, >0.32): 38 patients were enrolled in this study as study population.

Table 1: Distribution of the characteristics of the patients (N=120)

Characteristics	n	%
Age(years)		
31-40 yrs.	6	5.0
41-50 yrs.	35	29.2
51-60 yrs.	44	36.7
61-70 yrs.	28	23.3
71-80 yrs.	7	5.8
Mean ±SD	56.05± 9.81	
Min-Max	32-80	
Sex		
Male	98	81.7
Female	22	18.3
BMI(kg/m^2)		
Under weight	2	1.7
Normal	37	30.8
Over weight	25	20.8
Obese	56	46.7
Mean ±SD	24.50±2.86	
Min-Max	17.78-31.89	
Risk factors		
Diabetes mellitus	60	50.0
Hypertension	92	76.7
Smoker	49	40.8
Family H/O CAD	19	15.8
Diagnosis		
NSTEMI	101	84.2
Unstable Angina	19	15.8

Table 1 showed the characteristics of the patients. The maximum patients age group were between 51 to 60 years. The mean age of the patients was 56.05±9.81 years. 81.7% patients were male and 18.3% patients were female. Male, female ratio was 4.45. Male were predominant in this study than female. The mean BMI of the patients was 24.50 ±2.86 kg.m^2. Half (50.0%) of the patients had diabetes mellitus, 76.7% patients had hypertension, 40.8% patients were smoker and 15.8% patients had family history of CAD. Out of all, 84.2% patients had NSTEMI and 15.8% patients had unstable angina.

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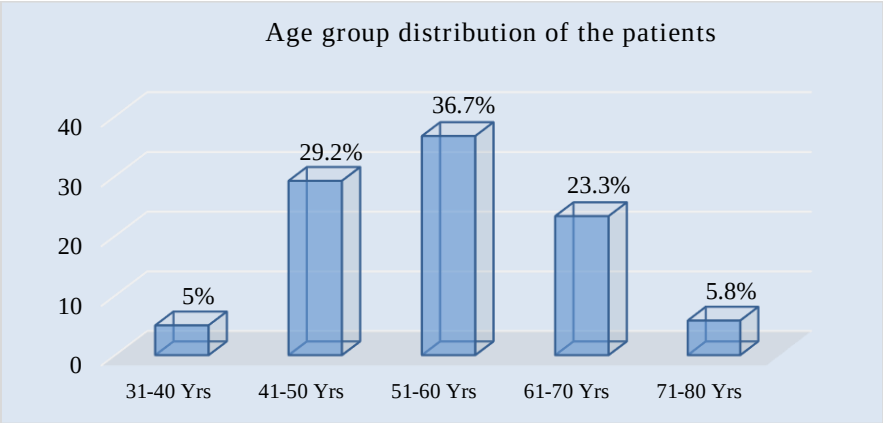

Figure I Bar chart showed age group wise patients distribution (N=120)

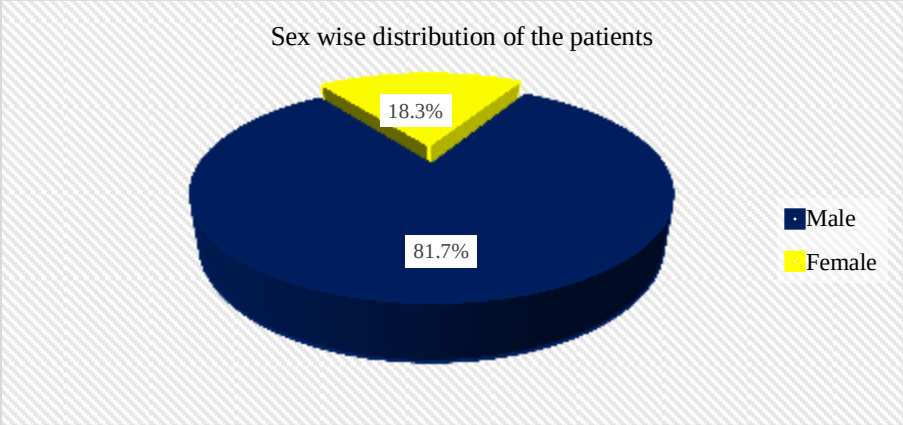

Figure II: Pie chart showed sex wise patients distribution (N=120)

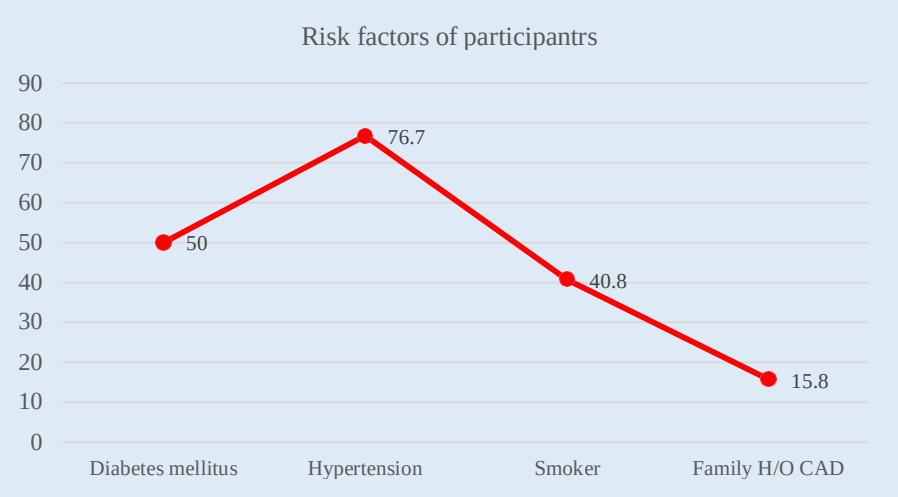

Figure III: Line chart showed Risk factors of the participants (N=120)

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Table 2: Descriptive statistics of biochemical variables (N=120)

Investigation variable's	Mean ±SD	Min-Max
Fasting lipid profile		
Total cholesterol(mg/dl)	169.46 ± 40.26	92.00-260.00
HDL(mg/dl)	36.53 ± 5.97	24.00-55.00
LDL(mg/dl)	119.91 ± 34.18	17.00-210.00
Triglycerides(mg/dl)	155.95 ± 36.87	100.00-308.00
TropI(ng/ml)	13.00 ± 19.83	00-109.00
Creatinine(mg/dl)	1.18 ± 0.24	0.80-2.00
RBS(mmol/L)	9.13 ± 3.99	3.20-24.00

Table 2 showed the biochemical variables of the patients. The mean total cholesterol, HDL, LDL and triglycerides of the patients were 169.46±40.26 mg/dl, 36.53±5.97 mg/dl, 119.91±34.18 mg/dl and 155.95±36.87 mg/dl respectively. The mean Trop I, creatinine and RBS of the patients were 13.00±19.83 ng/ml, 1.18±0.24 mg/dl and 9.13±3.99 mmol/L respectively.

Table 3: Distribution of the patients according to categories of AIP (N=120)

AIP	n	%
≤0.19	41	34.2
>0.19-0.32	41	34.2
>0.32	38	31.7
Mean ±SD	0.258 ± 0.127	
Min-Max	0.003-0.550	

Table 3 showed the AIP of the patients. 34.2% patients AIP were less than or equal to 0.19, 34.2% patients AIP were between more than 0.19 to 0.32 and 31.7% patients AIP were more than 0.32. The mean AIP of the patients was 0.258±0.127 with minimum and maximum values were 0.003 and 0.550 respectively.

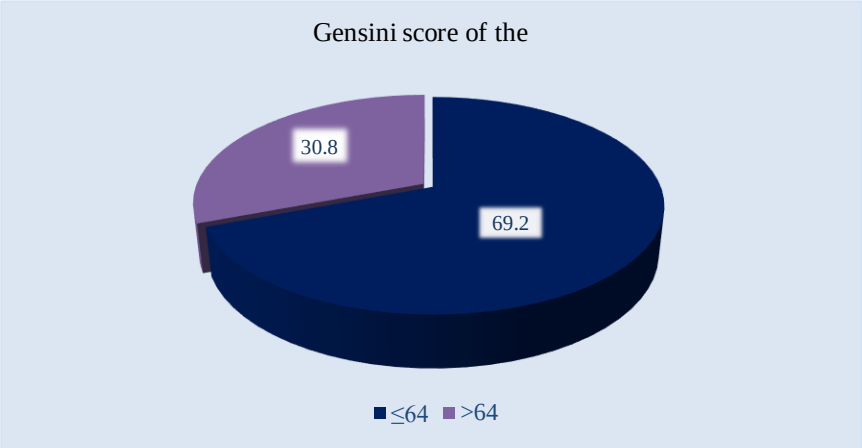

Figure IV: Pie chart showed patients according to Gensini score (N=120)

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Figure IV showed the Gensini score of the patients. The mean Gensini score of the patients was 57.86 ±45.27 with minimum and maximum values were 0 and 256 respectively. 69.2% patients Gensini score were less than or equal to 64 and 30.8% patients Gensini score were more than 64.

Table 4: Association of the patients according to demographic variables bycategories of AIP (N=120)

Demographic variables	AIP			P value
	≤0.19 (n=41)	>0.19-0.32 (n=41)	>0.32 (n=38)	
Mean ±SD Age	54.88 ± 10.30	54.07 ± 10.53	59.45 ± 7.57	0.032
Sex				
Male	27(65.9)	34(82.9)	37(97.4)	0.001
Mean ±SD BMI(kg/m^2)	24.51 ± 3.04	24.50 ± 2.84	24.47 ± 2.76	0.998

Table 4 showed that the association of demographic variables with AIP of the patients. There was statistically significant observed between age and sex with AIP groups.

Table 5: Distribution of the patients according to risk factors by categories of AIP (N=120)

Risk factors	AIP			P value
	≤0.19 (n=41)	>0.19-0.32 (n=41)	>0.32 (n=38)	
Diabetes mellitus	18(43.9)	21(51.2)	21(55.3)	0.590
Hypertension	29(70.7)	34(82.9)	29(76.3)	0.426
Smoker	11(26.8)	14(34.1)	24(63.2)	0.003
Family H/O CAD	4(9.8)	10(24.5)	5(13.2)	0.166

Table 5 showed the association of risk factors with AIP of the patients. There were not statistically significant difference observed between any parameter of risk factors and AIP groups except smoker. i.e., smoker was significantly increased with AIP groups.

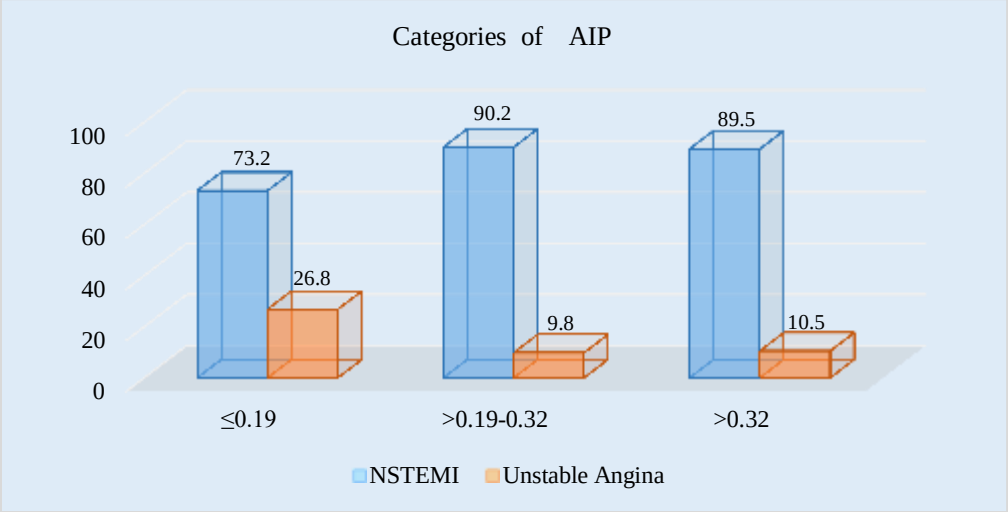

Figure V: Bar chart showed patients according to diagnosis by categories of AIP (N=120)

Figure 5 showed the Bar diagram of diagnosis with AIP of the patients. There was not statistically significant difference observed between diagnosis and AIP groups.

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Table 6: Association of the patients according to Gensini score by categories of AIP. (N=120)

Gensiniscore	AIP			P value
	≤0.19 (n=41)	>0.19-0.32 (n=41)	>0.32 (n=38)	
≤64	38(92.7)	31(75.6)	14(36.8)	<0.001
>64	3(7.3)	10(24.4)	24(63.2)	
Mean ±SD	20.68 ± 22.38	56.17 ± 19.90	99.79 ± 47.76	

Table 6 showed the association of Gensini score with AIP of the patients. The association of Gensini score with AIP groups was statistically significant. Also, the difference of Gensini score with different groups of AIP was statistically significant.

Table 7: Correlation of biochemical variables with AIP (N=120)

Biochemical variables with AIP	R value	P value
Fasting lipid profile		
Total cholesterol (mg/dl)	0.448	<0.001
HDL (mg/dl)	-0.655	<0.001
LDL (mg/dl)	0.415	<0.001
Triglycerides (mg/dl)	0.816	<0.001
TropI (ng/ml)	0.360	<0.001
Creatinine (mg/dl)	0.262	0.004
RBS (mmol/L)	0.091	0.321

Table 7 showed the bivariate correlation of AIP and biochemical variables. There were statistically significant difference observed between AIP versus any other parameter of biochemical variables except RBS. i.e., RBS were no linear correlation with AIP. All parameter whose were correlated were positively correlated except HDL. i.e., HDL was inverse correlated with AIP.

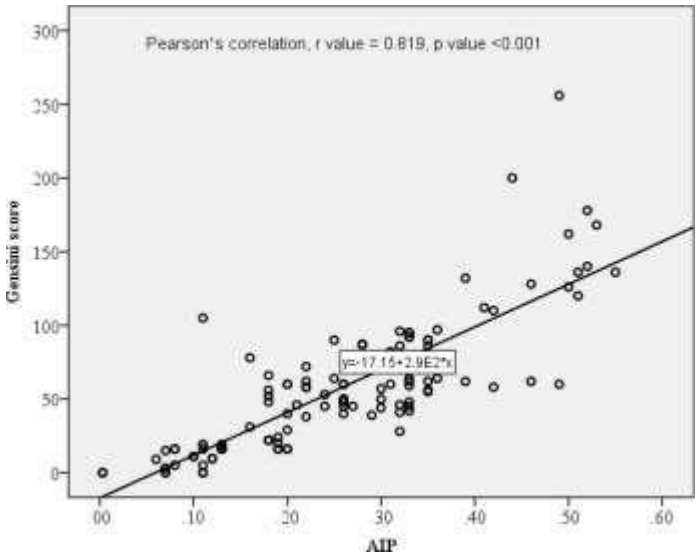

Figure VI: Correlation and regression of the patients according to AIP with Gensini score (N=120)

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Figure VI showed correlation and regression between AIP and Gensini score were shown in figure 6. There was positive correlation (r=0.819) observed between AIP and Gensini score, which was statistically significant. The linear regression equation was, y=17.15-290*x*, i.e. one unit of AIP was increased, Gensini score was increased by 290 times. R^2=0.671 means that, this model was best fit and statistically significant. i.e., 67.1% Gensini score explained by AIP.

Table 8: Logistic Regression Analysis of predictors of severe Gensini score (>64)

Variables	B	P value	Odds Ratio	95%C.I.for Odds Ratio	
				Lower	Upper
AIP≤0.19(reference)					
AIP>0.19-0.32	1.860	0.038	6.424	1.107	37.287
AIP>0.32	3.283	0.001	26.662	3.910	181.817
Age(Years)	0.001	0.999	1.000	0.944	1.059
Sex(Male/Female)	0.352	0.702	1.422	0.234	8.640
Smoker	0.307	0.574	1.359	0.466	3.968
LDL(mg/dl)	-0.002	0.820	0.998	0.983	1.014
TropI(ng/ml)	0.034	0.022	1.034	1.005	1.064
Creatinine(mg/dl)	-1.409	0.249	0.244	0.022	2.686

Table 8 showed the logistic regression analysis of predictors of severe gensini score. Final logistic regression model for severe Gensini score (>64) was created including significant predictors, AIP, age, sex, smoker, LDL, Trop I and serum creatinine. Model was statistically significant and Negelkerke R2 value was 0.416. In this model, AIP and Trop I were found significant independent predictor of severe Gensini score. i.e., AIP >0.19-0.32 were 6.424 times and AIP >0.32 were 26.662 times more risk than that of who's had AIP ≤0.19.

DISCUSSION

To our knowledge, this study is the first study in Bangladesh to evaluate the correlation of AIP with coronary artery disease severity in a population with NSTE ACS. This cross-sectional study was conducted in the Departmentof Cardiology, National Heart Foundation Hospital and research institute, Dhaka, over a period of one year from October, 2019 to August, 2020.A total of 120 patients were included in this study of which 41 patients were included in group I (AIP ≤ 0.19), 41 patients were included in group II (AIP >0.19-0.32) and 38 were included in group III (AIP >0.32). In present study mean age of patients were 56.05 ± 9.81 years. The commonest age group of study patients was 51 to 60 years in all groups. Mean age difference was not statistically significant. Rahman, et al., (2017) [6] showed nearly similar pattern of distribution in NSTE-ACS was 57.47±11.59 years. But there was difference in mean age with different studies done in home and abroad. Cai, et al., (2017) [26] showed mean age was 62.16±9.28. South Asians have multiple risk factors that pose potentially atherogenic condition. It may be dueto altered metabolic condition, frequent infection, inflammation, constant stress and narrowness of the arteries. CADmost probably occurs in relatively early age groups in our country. In this study,81.7% patients were male and 18.3% patients were female. Male and female ratio was 4.45:1. Male were predominant in this study than female. In Bangladesh & abroad, the various studies showed, the female patients formed a small percentage. Ilhamifithri, et al.,(2019) [31] 16% and Cai, et al., (2017) [26] 31.64% patient in their respective study. In present study shows that, themale patients having high AIP were more than that of female patients and the association reached the statistical levelof significance [male 65.9% in Group-I (AIP ≤0.19), 82.9% in group-II (AIP >0.19-0.32) and 97.4% in group III (AIP>0.32)]. There is significant difference in clinical presentation. NSTEMI is the predominant presentation in all group, (73.2%) in group - I (AIP≤0.19), (90.2%) in group- II (AIP>0.19-0.32) and (89.5%) in group- III (AIP>0.32).

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Whereas unstable angina was (26.8%) in group - I, (9.8%) in group-II and (10.5%) in group-III. There was similar type of risk factors like diabetes, hypertension, obesity and family history of CAD in all the groups. But statistically significant difference was not observed among all three groups. Hypertension is a well-known risk factor for coronary artery disease. In this study, hypertension, was present in 76.7% of total study population (70.7%, 82.9% and 76.3% in group I, group II and group III respectively), which was not statistically significant. Cai, et al., (2017) [26] was also found 70.37% hypertensive patient. Overall prevalence of DM was 50.0% (43.9%, 51.2% and 55.3%in group I, group II and group III respectively). Amin, et al., (2014) [17] found 42.4% diabetic patient in their study. In this study between three groups it was not statistically significant. Obesity or excess adiposity is one of the most important determinants of coronary artery disease. In this study, mean BMI was 24.50±2.86. Niroumand, et al., (2015) [32] showed almost similar type of mean BMI 25.1±5.20 in their study. Positive history of smoking, present in 40.9% (26.8% in group I, 34.1% in group II and 63.2% in group III) which is statistically significant. Family history of CAD 9.8% in group I,24.5% in group II and 13.2% in group III which is not statistically significant. Low HDL cholesterol and high triglyceride levels are part of atherogenic dyslipidemia, accompanied by high AIP scores can trigger the formation of atherosclerotic plaques resulting in coronary artery disease, causing significant clinical and hemodynamic disturbance in ACS patients (Ilhamifithri, et al., 2019). [31] The mean HDL cholesterol, triglyceride levels and AIP levels in present study were 36.53±5.97mg/dl, 155.95±36.87 mg/dl and 0.26±0.13 respectively. The mean HDL cholesterol levels of the study subjects included low HDL criteria, and mean triglyceride levels including borderline high triglyceride criteria based on NCEP ATP III. The subjects had AIP withhigh cardiovascular risk according to Dobiás˘ ová and Frohlich, 2001. [22] The mean HDL cholesterol level was 36.53±5.97mg/dl which is similar to Ilhamifithri, et al., (2019) [31] that investigated clinical and angiographic characteristics in ACS patients getting HDL cholesterol 34.8±8.7 mg/dl. The mean of triglyceride level of the subjects was 155.95±36.87mg/dl. Ilhamifithri, et al., (2019) [31] showed the mean TG 155.8±51.8mg/dl which is similar to present study. Different result obtained by Bhardwaj, et al., (2013) [28] in India who examined the association of AIP with coronary artery stenosis in patient with ACS received triglyceride level 140.6±6.3mg/dl. The mean AIP in this study was 0.26±0.13. In Cai, et al. (2019) [26] study the mean level of AIP in whole population was 0.312. The mean AIP was 0.28 in study conducted by Ilhamifithri, et al., (2019) [31] which is similarto this study. Bhardwaj et al., (2013) [28] obtained high mean AIP value 0.39. This discrepancy might be partly interpreted by different population, region and ethnicity. In the current study coronary angiographic severity was assessed by Gensini score. Cai, et al. (2019) [26] described Gensini score as severe >64. It was observed that 69.2% patients score ≤64, 30.8% patients score severe >64. This study shows that that the association of Gensini score withAIP of the patients. In AIP less than or equal to 0.19 group, 92.7% patients with Gensini score were less than or equal to 64 and only 7.3% patients with Gensini score were more than 64, in AIP between 0.19 to 0.32 group, 75.6%patients Gensini score were less than or equal to 64 and 24.4% patients Gensini score were more than 64 and on the other hand, in AIP more than 0.32 group, 36.8% patients Gensini score were less than or equal to 64 and 63.2% patients Gensini score were more than 64. The mean Gensini score of the patients with AIP less than or equal to 0.19, between 0.19 to 0.32 and more than 0.32 groups were 20.68±22.38, 56.17±19.90 and 99.79±47.76 respectivelyand the median of these three AIP groups were 16, 53 and 91 respectively. The association of Gensini score with AIP groups was statistically significant ($p<0.05$). Also, the difference of Gensini score with different groups of AIP was statistically significant. In this study, it was hypothesised that AIP can assess severity of coronary artery disease in patients with Non ST segment Elevation Acute Coronary Syndrome. After analysis, it was found that there was positive correlation ($r=0.819$) observed between AIP and Gensini score, which was statistically significant. llhamifithri, et al., (2019) [31] revealed that AIP was positively correlate with Gensini score ($r=0.426$, $p<0.05$). These findings were consistent with this study. Logistic regression analysis of predictors of severe Gensini score (>64) was done. In this model, AIP was predictor of severe Gensini score. i.e., AIP >0.19-0.32 were 6.424 times andAIP >0.32 were 26.662 times and AIP >0.32 were 26.662 times more risk than that of who's had AIP ≤0.19.

LIMITATIONS

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Although the result of this study supports the hypothesis, there were some limiting factorswhich might have an effect on the results: This study was conducted in only one center and majority of study population were male. Inthis study assessment of coronary angiographic findings was limited to visual interpretation, with inter- and intra- observer variability. Except those, the sample size was small and study period was short.

RECOMMENDATIONS

Atherogenic Index of Plasma calculated from fasting lipid profile might play role in assessment of coronary artery disease severity in patient with NSTE-ACS. Large scale, randomized and multicenter studies are needed to validate the findings ofpresent study. If the utility of AIP is supported by future studies, this may be added to existing routine examination in patient with NSTE-ACS.

CONCLUSION

The present study showed that AIP (Atherogenic Index of Plasma) was an independent predictor of coronary artery disease severity in patients with Non ST segment Elevation Acute Coronary Syndrome. AIP was significantly increased and associated with significant CAD in patients presenting with NSTE ACS patients. Thus AIP assessment can be effective in diagnosis of patients with NSTE-ACS and planning strategies for their treatment like early revascularization or early hospital discharge as well as risk stratification.

REFERENCE

1. Ahmad, T., Alam, M.B., Khan, A., Islam, A.M., Hossain, Z. and Asaduzzaman, K., 2017.Study on risk factors and pattern of coronary artery involvement in young acute coronary syndrome patients. *Bangladesh Heart Journal*, 32(1), pp.40-44.
2. Roth GA, Johnson C, Abajobir A, Abd-Allah F, Abera SF, Abyu G, Ahmed M, Aksut B, Alam T, Alam K, Alla F, et el. Regional, and National Burden of Cardiovascular Diseases for 10 Causes, 1990 to 2015. J Am Coll Cardiol. 2017 Jul 4;70(1):1-25. doi: 10.1016/j.jacc.2017.04.052. Epub 2017 May 17. PMID: 28527533; PMCID: PMC5491406.
3. Silbiger, J.J., Ashtiani, R., Attari, M., Spruill, T.M., Kamran, M., Reynolds, D., Stein, R. and Rubinstein, D., 2011. Atheroscerlotic heart disease in Bangladeshi immigrants: risk factors and angiographic findings. *International Journal of Cardiology*, 146(2), pp. e38- e40.
4. Islam, A.M. and Majumder, A.A.S., 2013. Coronary artery disease in Bangladesh: A review. *Indian Heart Journal*, 65(4), pp.424-435.
5. Malik, A., 1976. Congenital and acquired heart diseases: (A survey of 7062 persons). *Bangladesh Medical Research Council Bulletin*, 2(2), pp.115-19.
6. Rahman, A., Raka, S.C. and Ahmed, S.M., 2017. Prevalence of Cardiovascular Diseases and Prescription Patterns in a Randomly Selected Population in Bangladesh. *Biomedical& Pharmacology Journal*, 10(2), pp.607-613.
7. Chowdhury, M.Z.I., Haque, M.A., Farhana, Z., Anik, A.M., Chowdhury, A.H., Haque, S.M., Marjana, L.L.W., Bristi, P.D., Al Mamun, B.A., Uddin, M.J., Fatema, J., Rahman, M.M., Akter, T., Tani, T.A. and Turin, T.C., 2018. Prevalence of cardiovascular disease among Bangladeshi adult population: a systematic review and meta-analysis of the studies. *Vascular Health and Risk Management*, 14, pp.165-181.
8. Saquib, N., Saquib, J., Ahmed, T., Khanam, M.A. and Cullen, M.R., 2012. Cardiovascular diseases and type 2 diabetes in Bangladesh: a systematic review and meta-analysis of studies between 1995 and 2010. *BMC Public Health*, 12:434.
9. Roffi, M., Patrono, C., Collet, J.P., et al. (2016) 2015 ESC Guidelines for the Management of Acute Coronary Syndromes in Patients Presenting without Persistent ST-Segment Elevation: Task Force for the Management of Acute Coronary Syndromes in Patients Presenting without Persistent ST-Segment Elevation of the European Society of Cardiology (ESC). European Heart Journal, 37, 267-315. https://doi.org/10.1093/eurheartj/ehv320
10. De Wood, M.A., Spores, J., Notske, R., Mouser, L.T., Burroughs, R., Golden, M.S. and Lang, H.T., 1980.

ISSN: 0975-3583, 0976-2833 VOL14, ISSUE04, 2023

Prevalence of total coronary occlusion during the early hours oftransmural myocardial infarction. *New England Journal of Medicine*, 303(16), pp.897- 902.

11. Rosamond, W., Flegal, K., Furie, K., Go, A., Greenlund, K., Haase, N., Hailpern, S.M., Ho, M., Howard, at el. ; American Heart Association Statistics Committee and Stroke Statistics Subcommittee, 2008. Heart disease and stroke statistics--2008 update: a report from the American Heart Association Statistics Committee and Stroke Statistics Subcommittee. *Circulation*, 117(4), pp. e25-e146.
12. Amsterdam, E.A., Wenger, N.K., Brindis, R.G., Casey, D.E., Ganiats, T.G., Holmes, D.R., Jaffe, A.S., Jneid, H., Kelly, R.F., Kontos, M.C., Levine, G.N., Liebson, P.R., Mukherjee, D., Peterson, E.D., Sabatine, M.S., Smalling, R.W., Zieman, S.J., Anderson, J.L., Halperin, J.L., Albert, N.M., Bozkurt, B., Curtis, L.H., DeMets, D., Fleisher, L.A., Gidding, S., Guyton, R.A., Hochman, J.S., Kovacs, R.J., Ohman, E.M., Pressler, S.J., Sellke, F.W., Shen, W.K., Stevenson, W.G., Wijeysundera, D.N. and Yancy, C.W., 2014. 2014 AHA/ACC guideline for the management of patients with non-st-elevation acute
13. Braunwald E, Antman EM, Beasley JW, Califf RM, Cheitlin MD, Hochman JS, Jones RH, Kereiakes D, at el. American College of Cardiology/American Heart Association Task Force on Practice Guidelines. ACC/AHA guideline update for the management of patients with unstable angina and non-ST-segment elevation myocardial infarction-2002: summary article: a report of the American College of Cardiology/American Heart Association Task Force on Practice Guidelines (Committee on the Management of Patients with Unstable Angina). Circulation. 2002 Oct 1;106(14):1893-900. doi: 10.1161/01.cir.0000037106.76139.53. PMID: 12356647.
14. Fox, K.A., Goodman, S.G., Klein, W., Brieger, D., Steg, P.G., Dabbous, O. and Avezum, A., 2002. Management of acute coronary syndromes. Variations in practice and outcome. Findings from the Global Registry of Acute Coronary Events (GRACE). *European Heart Journal*, 23(15), pp.1177-1189.
15. Libby, P. and Theroux, P. (2005) Pathophysiology of Coronary Artery Disease. Circulation, 111, 3481-3488. https://doi.org/10.1161/CIRCULATIONAHA.105.537878
16. Parinita, K., Madhuri, K.V. and Sreekanth, V., 2012. Study of serum lipid profile in individuals residing in and around Nalgonda. *International Journal of Pharmacy and Biological Sciences*, 2(*1)*, pp.110-116.
17. Amin, M.R., Rahman, M.A., Alam, N., Hasan, M.N. and Hasan, G.M.S., 2014. Relationship between triglyceride HDL-cholesterol ratio and severity of coronary artery disease in patient with acute coronary syndrome. *Bangladesh Medical Journal*, 43(3), pp.157-161
18. Ullah, A. and Barman, A., 1991. Coronary heart disease and food. *Bangladesh Heart Journal*, 6(1), pp.5-12.
19. Bhopal, R., Unwin, N., White, M., Yallop, J., Walker, L., Alberti, K.G.M.M., Harland, J., Patel, S., Ahmad, N., Turner, C., Watson, B., Kaur, D., Kulkarni, A., Laker, M. and Tavridou, A., 1999. Heterogeneity of coronary heart disease risk factors in Indian, Pakistani, Bangladeshi, and European origin populations: cross sectionalstudy. *BMJ*, 319(7204), pp.215-220.
20. Khazaal, M.S., 2013. Atherogenic Index of Plasma (AIP) as a parameter in predicting cardiovascular risk in males compared to the conventional dyslipidemic indices (cholesterol ratios). *Karbala Journal of Medicine*, 6(1), pp.1506-1513.
21. Daniels, L.B., Laughlin, G.A., Sarno, M.J., Bettencourt, R., Wolfert, R.L. and Barrett- Connor, E., 2008. Lipoprotein-associated phospholipase A2 is an independent predictorof incident coronary heart disease in an apparently healthy older population: The Rancho Bernardo Study. *Journal of the American College of Cardiology*, 51(9), pp.913-919.
22. Dobiás˘ ová, M. and Frohlich, J., 2001. The plasma parameter log (TG/HDL-C) as an atherogenic index: correlation with lipoprotein particle size and esterification rate inapob- lipoprotein-depleted plasma (FER_{HDL}). *Clinical Biochemistry*, 34(7), pp.583-588.
23. Dobiasova, M., 2006. AIP--atherogenic index of plasma as a significant predictor of cardiovascular risk: from research to practice. *Vnitrni Lekarstvi*, 52(1), pp.64-71.
24. Lafta, M.A., 2014. A comparative study for some atherogenic indices in sera of myocardial infarction,

ISSN: 0975-3583, 0976-2833 VOL14, ISSUE04, 2023

ischemic heart disease patients and control. *J Natural Sci Res*, pp.121-8.

25. Zhu, X., Yu, L., Zhou, H., Ma, Q., Zhou, X., Lei, T., Hu, J., Xu, W., Yi, N. and Lei, S., 2018. Atherogenic index of plasma is a novel and better biomarker associated withobesity: a population-based cross-sectional study in China. *Lipids in Health and Disease*, 17: 37.
26. Cai, G., Shi, G., Xue, S. and Lu, W., 2017. The atherogenic index of plasma is a strong and independent predictor for coronary artery disease in the Chinese Han population. *Medicine*, 96:37.
27. Dobiasova, M., Frohlich, J., Sedova, M., Cheung, M.C. and Brown, B.G., 2011. Cholesterol esterification and atherogenic index of plasma correlate with lipoprotein size and findings on coronary angiography. *Journal of Lipid Research*, 52(3), pp.566-571.
28. Bhardwaj, S., Bhattacharjee, J., Bhatnagar, M.K. and Tyagi, S., 2013. Atherogenic index of plasma, castelli risk index and atherogenic coefficient-new parameters in assessing cardiovascular risk. *International Journal of Pharmacy and Biological Sciences*, 3(3),pp.359-64.
29. Susanti, E., Donosepoetro, M. and Lawrence, G.S., 2009. Relations Between Atherogenic Index of Plasma, Ratio of Small Dense Low Density Lipoprotein/Lecithin Cholesterol Acyl Transferase and Ratio of Small Dense Low Density Lipoprotein/Cholesteryl Ester Transfer Protein of Controlled and Uncontrolled Type 2 DM. *The Indonesian Biomedical Journal*, 1(2), pp.38-44.
30. Ai, M., Otokozawa, S., Asztalos, B.F., Ito, Y., Nakajima, K., White, C.C., Cupples, L.A., Wilson, P.W. and Schaefer, E.J., 2010. Small dense LDL cholesterol and coronary heart disease: results from the Framingham Offspring Study. *Clinical Chemistry*, 56(6), pp.967-976.
31. Ilhamifithri, I., Yaswir, R., Alia, E. and Efrida, E., 2019. Correlation of atherogenic indexof plasma with stenosis level of coronary artery in acute coronary syndrome, Indonesian Journal of Clinical Pathology and Medical Laboratory, 25(1), pp.53-57.
32. Niroumand, S., Khajedaluee, M., Khadem-Rezaiyan, M., Abrishami, M., Juya, M., Khodaee, G. and Dadgarmoghaddam, M., 2015. Atherogenic Index of Plasma (AIP): A marker of cardiovascular disease. *Medical journal of the Islamic Republic of Iran*, Vol.29: 240.