



# **A Study of Atherogenic Plasma & Triglyceride-Glucose Indices and Monocyte/HDL-C Ratios in Colon Cancer Patients**

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## **Authors' contributions**

*This work was carried out in collaboration between both authors. Both authors read and approved the final manuscript.*

## **Article Information**

DOI: 10.9734/JPRI/2021/v33i46B32935

### **Editor(s):**

(1) Dr. Syed A. A. Rizvi, Nova Southeastern University, USA.

(2) Dr. Farzaneh Mohamadpour, University of Sistan and Baluchestan, Iran.

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(1) Michael Bordonaro, GCSOM, USA.

(2) V. S. Kiranmayi, Sri Venkateswara Institute of Medical Sciences, India.

Complete Peer review History: <https://www.sdiarticle4.com/review-history/75363>

**Received 08 August 2021**

**Accepted 17 October 2021**

**Published 21 October 2021**

**Original Research Article**

## **ABSTRACT**

Colon cancer is a tumor of the large intestine. It is the third most common cause of cancer-related death in the United States. However, most people with colon cancer get better if the cancer is found early. The atherogenic index of plasma (AIP), triglyceride-glucose (TyG) index, are strongly associated with atherogenesis of the coronary artery however, studies on its relationship with cancer are limited in the literature. This study aimed to investigate the association of the AIP, TyG index, and Monocyte/HDL-C with colon cancer patients.

**Keywords:** Cancer; colon; atherogenic index; monocyte-HDL-C ratio.

## **1. INTRODUCTION**

Most common causes of death around the globe are cardiovascular diseases and cancer; both

have similar etiopathogenesis. Genetic and environmental factors, smoking, and viral agents play an important role in its etiopathogenesis. They both diseases bring inflammation,

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uncontrolled cell proliferation and oxidative stress. The later causes the deterioration of cell proliferation, the development of atherosclerotic plaque, as well as the formation of cancer [1].

The progression of atherosclerotic plaque and the biology of tumor formation and metastasis are linked to angiogenesis. Major molecular inflammatory pathways and their nuclear transcription factors such as NFkappaB are involved in the pathogenesis of both atherosclerosis and cancer. Altered expression of thrombolysis-related proteases is involved in atherosclerotic plaque progression, cancer invasion and metastasis [2-4].

The atherogenic plasma index is a better indicator than other lipid ratios and lipid parameters in predicting cardiovascular diseases [5]. The atherogenic plasma index (AIP) is an index of triglycerides and high-density lipoprotein cholesterol. It has been used to measure blood lipid levels and is widely used as an optimal indicator of atherosclerotic cardiovascular diseases associated with dyslipidemia [6].

Inflammation is one of the main mechanisms during the formation of cancer and atherosclerotic plaque. During inflammation, proinflammatory cytokines secreted from monocytes cause the formation of atherosclerotic plaque. HDL-C cholesterol neutralizes these monocytic effects. Therefore, features such as monocyte count to HDL-cholesterol ratio (MHR) may indicate the patient's inflammatory status. The relationship between MHR and atherosclerosis cases has been demonstrated where MHR has emerged as a new marker for atherosclerotic cardiovascular diseases as reported earlier [7].

Triglyceride glucose index is a method that shows insulin resistance that causes the release of proinflammatory and anti-inflammatory cytokines to causes chronic inflammation. As a result, it causes cancer and atherosclerosis [8].

This study was aimed to determine the atherogenic plasma index, Triglyceride-Glucose index, and the rations of Monocyte/Lymphocyte, which are inflammation markers. It was also aimed to determine the relationship between atherosclerosis and colon cancer in the control group and individuals who had colon cancer. Determination of these parameters would help to assess the risk of colon cancer.

## 2. MATERIALS AND METHODS

### 2.1 Study Population

Patients over 18 years of age who were diagnosed with colon cancer histopathologically in Afyonkarahisar Private Parkhayat Hospital and a healthy control group were included in the study. It consisted of 30 colon cancer patients, 16 females, 14 males, and 37 healthy controls, 13 females and 24 males.

Blood lipid profile and glucose values of patients and healthy subjects were recorded. Postoperative atherogenic plasma index, monocyte/HDL-C and Triglyceride-Glucose indexes of colon cancer patients were compared with both control groups. AIP was calculated using the formula involving the logarithm of the molar ratio of triglyceride to high-density lipoprotein cholesterol.

### 2.2 Biochemical Tests

Venous blood samples from all participants were obtained and used to measure routine biochemical indexes.

Blood glucose (Glu), lipid profile including total cholesterol (TC), triglyceride (TG), high-density lipoprotein cholesterol (HDL-C) and low-density lipoprotein cholesterol (LDL-C), were measured with commercial kits using an automated analyzer. Blood monocyte cell count were determined using an automated blood cell counter.

### 2.3 Data Analysis

All data were analyzed by SPSS (statistical package for social sciences) for Windows. The assumptions that must be met were tested to decide which tests (parametric/nonparametric tests) to apply first in the data analysis. Kolmogorov-Smirnov, Shapiro Wilk test, the other assumptions of the normal distribution, kurtosis and skewness values and histogram graph were used to decide the normality of the distribution. Numerical data are shown as median and quarterly deficits (Inter Quantile Range). The Man Whitney-U test was used to compare two independent groups. The effect size was calculated with the equation  $r=Z/\sqrt{N}$  [9]. The relationship between categorical variables was examined using Chi-square and Fisher's exact test. The significance level of 0.05 was used as a criterion to interpret whether the obtained values were significant or not.

**Table 1. Risk levels of normal and colon group persons**

		Normal		Colon	
		n	%	n	%
AIP Group	Low Risk	7	23.3	2	5.7
	Medium Risk	2	6.7	1	2.9
	High Risk	21	70.0	32	91.4
TyG index Group	No insulin resistance	5	16.7	2	5.7
	Insulin resistance	25	83.3	33	94.3

**Table 2. Relationship between groups and risk levels**

		Group		Statistic test
		Normal	Colon	
TyG index Group	No insulin resistance	5 <sub>a</sub> (16.7)	2 <sub>a</sub> (5.7)	X <sup>2</sup> : 2.01 p: 0.234
	Insulin resistance	25 <sub>a</sub> (83.3)	33 <sub>a</sub> (94.3)	
AIP Group	Low Risk	7 <sub>a</sub> (23.3)	2 <sub>b</sub> (5.7)	fisher's exact test: 4.96 p:0.02
	Medium Risk	2 <sub>a</sub> (6.7)	1 <sub>a</sub> (2.9)	
	High Risk	21 <sub>a</sub> (70)	32 <sub>b</sub> (91.4)	

**Table 3. Comparison of blood values by groups**

	Normal Median(Q1-Q3)	Colon Median(Q1-Q3)	z	p	Width of Influence
Total cholesterol	194.0 (154.0-216.0)	185.5 (161.0-208.5)	-0.53	0.60	
Triglyceride	121.5 (87.0-157.0)	149.0 (115.0-199.0)	-2.35	0.02	0.30
Hdl	52.0 (46.0-64.0)	45.5 (36.5-57.0)	-2.26	0.02	0.29
Aip	0.3 (0.2-0.5)	0.5 (0.4-0.7)	-2.84	0.01	0.36
Ldl	114.0 (95.0-133.0)	106.5 (89.0-117.0)	-1.10	0.27	
Glu	106.0 (100.0-117.0)	107.0 (94.0-127.0)	-0.06	0.95	
TyG index	4.8 (4.6-4.9)	4.9 (4.7-5.2)	-2.33	0.02	0.30
Monocyte/hdl	7.67 (6.5-11.1)	11 (7.8-17.3)	-2.52	0.01	0.32

### 3. RESULTS

According to the AIP, the lower, medium, and high risks were 23.3, 6.7 and 70 % in the normal group, while they were 5.7, 2.9 and 91.4 % for colon group, respectively (Table 1). According to the TG index values, 16.7 % of the normal group does not have insulin resistance, while 83.3 % has it. In the colon group, the incidence of insulin resistance was 94.3 %, while the rate of absence was 5.7 % (Table 1).

There was no statistically significant relationship between TyG index risk levels and groups (X<sup>2</sup>: 2.01 p>0.05). However, there was a statistically significant relationship between AIP index risk levels and groups (fisher's exact test 4.96 p<0.05). While the low-risk rate was 23.3 % in the normal group, it was 5.7 % in the colon group. Additionally, the high risk rate was 70 % in the normal group while it was 91.4 % in the colon group (Table 2).

Total cholesterol, LDL-C and GLU values did not show a statistically significant difference between the groups (p>0.05) (Table 3).

Triglyceride values show a statistically significant difference between the groups (z:-2.35 p<0.05). The triglyceride median values of the normal group are lower than the colon group. According to the calculated effect size, the significant difference is at the medium effect (r:0.30).

HDL-C values show a statistically significant difference between the groups (z:-2.26 p<0.05). Looking at the median values, it is seen that the HDL-C values of the normal group are higher than the colon group. According to the calculated effect size, the significant difference is of medium effect (r:0.29).

AIP values show a statistically significant difference between the groups (z:-2.84 p<0.05). The median AIP values of the normal group are

lower than the column group. According to the calculated effect size, the significant difference is at the medium effect level ( $r:0.36$ ).

TyG index values show a statistically significant difference between the groups ( $z:-2.33$   $p<0.05$ ). The median of TG GLU index values of the normal group is lower than the colon group. According to the calculated effect size, the significant difference is at the medium effect level ( $r:0.30$ ).

Monocyte/HDL-C values showed a statistically significant difference between the groups ( $z:-2.52$   $p<0.05$ ). As the median values show, the Monocyte/HDL-C values of the normal group are lower than the colon group. According to the calculated effect size, the significant difference is at the medium effect level ( $r:0.32$ ) (Table 3).

#### 4. DISCUSSION AND CONCLUSION

In our study, atherogenic plasma index TyG index was found to be high in colon cancer patients. In these patients, monocyte/HDL-C cholesterol was detected at high levels.

Atherogenic plasma index and Monocyte/HDL-C have been used as indicators of atherosclerosis in cardiovascular diseases. Inflammation is one of the main mechanisms in the etiopathogenesis of both atherosclerosis and cancer. Factors such as smoking, and obesity are common risk factors. In a previous study, high triglyceride levels were found to be prognostic risk factors in stage 3 and high-risk stage 2 colorectal cancer [10]. They suggested that carotid atherosclerosis may contribute to risk modeling in the CRC screening program [11]. In individuals with abnormal carotid intima-media thickness or presence of plaque, a significantly higher mean and high-risk adenoma prevalence was detected compared to individuals with normal carotid intima-media thickness or without plaque [12]. Carotid intima media thickness was found to be a risk factor for high-risk adenomas. In our study, atherogenic plasma index and MHR, which are markers of atherosclerosis, were found to be high in colon cancer patients that is properly inline with the literature.

Insulin resistance is associated with colorectal cancer [13]. Insulin resistance has been found to be associated with increased IGF-1 levels that causes tumor progression[14]. NF- $\kappa$ B signaling pathway is important in CRC tumorigenesis [15]. Insulin resistance affects this pathway and

induces inflammation. The TyG index, which is used to determine insulin resistance, is used. Takuro et al. has found that the TyG index could be used to predict the occurrence of colorectal cancer [11]. In our study, consistent with the literature, TyG index was found to be high in patients with colon cancer.

As a result; we think that in the colon cancer screening program, parameters such as atherogenic plasma index, monocytes/HDL-C cholesterol and triglyceride glucose index can be used to define risk groups. High-risk individuals can be followed up more closely. Thus protective measures can be taken in this regard.

#### CONSENT

It is not applicable.

#### ETHICAL APPROVAL

The study was accepted by Afyon Karahisar University of Health Sciences clinical research ethics committee with the decision numbered 2011-KAEK-2.

#### COMPETING INTERESTS

Authors have declared that no competing interests exist.

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