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Original Article

Relationship Between Level of Simple Carbohydrate and Trans Fat Intake with Severity of Coronary Artery Stenosis Based on Gensini Score at Kariadi Hospital Semarang

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Abstract

Background : Coronary artery disease accounts for 111 million (27%) out of 400 million cases of cardiovascular disease worldwide. Regular consumption of foods high in trans fats and simple carbohydrates is a major cause of increased blood lipid and glucose levels, which are key risk factors for coronary artery disease.

Aims : This researches to examine the relationship between the amount of simple carbohydrate and trans fat intake and the severity of coronary artery stenosis based on the Gensini score.

Methods : This research used a cross-sectional observational design involving 56 patients with chronic coronary syndrome who had undergone coronary angiography and were found to have stenosis in their coronary arteries. The parameters assessed included the amount of simple carbohydrate intake, trans fat intake, LDL levels, HDL levels, triglyceride levels, HbA1C levels, hs-CRP levels, oxLDL levels, and Gensini score.

Results : There was a significant relationship between the amount of simple carbohydrate intake and the severity of coronary artery stenosis based on the Gensini score (p=0.004), and between the amount of trans fat intake and the severity of coronary artery stenosis based on the Gensini score (p=0.02). Additionally, there was a significant relationship between trans fat levels and LDL levels (p=0.017), and oxLDL levels (p=0.014), but not with HDL, triglyceride, or hs-CRP levels (p>0.05). Confounding variables such as age, gender, socioeconomic status, body mass index, hypertension, diabetes mellitus, dyslipidemia, statin use, antidiabetic drug use, physical activity, and statin use showed no significant relationship (p>0.05).

Conclusion : There is a significant relationship between the amount of simple carbohydrate and trans fat intake and the severity of coronary artery stenosis based on the Gensini score.

Keywords : Coronary Artery Disease, Gensini Score, Simple Carbohydrates, Trans Fats

INTRODUCTION

The prevalence of cardiovascular disease, particularly Coronary Heart Disease (CHD), continues to increase globally and is a major cause of death and reduced quality of life. Lifestyle changes, especially the consumption of fast food or processed foods high in simple carbohydrates and trans fats, are primary factors in the increase of blood lipid and glucose levels, which are major risk factors for CHD.[1,2]

The 2021 National Socioeconomic Survey (Susenas) Microdata from the Central Statistics Agency (BPS) included 339,670 respondents representing Indonesia's 271.5 million population in 2021. 14.9 million Indonesians, or 17.6%, consumed excessive amounts of sugar, with an average sugar intake of 65.12 grams per person per day. The second most consumed type of food or beverage was granulated sugar, followed by sweetened condensed milk and brown sugar. Indonesians' carbohydrate intake continued to increase from 1961 to 2013. In 1961, it was 1,439.13 kcal, and in 2013, it rose to 2,008 kcal. Despite the increase, the proportion of total calories consumed tended to decrease, from 78.9% in 1961 to 72 percent in 2013. This indicates a trend toward reducing carbohydrate intake among Indonesians. But on the other hand, there has been an increase in fat intake. For example, in 1961, the proportion of fat intake compared to total calories was 13%. In 2013, it increased to 18.7%. Similarly, protein intake increased from 7.72% to 8%. Data from the National Socioeconomic Survey (Susenas) also shows a similar trend, especially among high-income communities. On average, the poor (77.8%) consumed more carbohydrates than the wealthy (68.8 %). Total calorie intake from fat, carbohydrates, and fat also increased by 58%. In 1961, the total calorie intake was 1,824 kcal, rising to 2,883 kcal in 2013. Obesity significantly increases the risk of type 2 diabetes and premature atherothrombosis. Approximately 13% of adults in the United States (34.1 million) have diabetes (mostly type 2 diabetes), with significant variation by age, gender, race/ethnicity, and socioeconomic status, and this number is projected to increase significantly by 2050. This condition is accompanied by rising obesity, which increases the risk of type 2 diabetes and atherothrombosis. Factors such as age, gender, LDL cholesterol, smoking, and diabetes mellitus (DM) are related to the severity of coronary lesions. DM specifically accelerates CHD through vascular damage and endothelial dysfunction.[3–5, 21]

Quantitatively assess the severity of CHD, the Gensini Score (GS) is used, based on coronary angiography results, to calculate the atherosclerotic plaque burden. This score is important for disease management and long-term prognosis. Nutritional intake, especially of trans fats, has a significant impact on coronary artery disease and has been shown to be a predictor of the severity of coronary artery lesions based on the Gensini Score. Trans fats trigger adverse effects through atherogenic processes, including increased pro-inflammatory cytokines and decreased nitric oxide levels. Dietary patterns high in simple carbohydrates and trans fats, such as in some traditional market snacks in Indonesia, potentially increase the risk of CHD.[6,7]

Previous research indicates that high carbohydrate and trans fat intake increases CHD risk factors such as metabolic syndrome, type II DM, and dyslipidemia. To measure nutrient intake, the Food Frequency Questionnaire (FFQ) is a valid and representative method for identifying eating habits and specific nutrient intake.[7,8,22]

Considering the important role of nutritional intake in atherosclerosis and the lack of research quantitatively linking the intake of simple carbohydrates and trans fats with the severity of coronary artery stenosis based on the Gensini Score, this study aims to investigate this relationship at Dr. Kariadi General Hospital Semarang.

METHODS

This study was an observational analytical study with a cross-sectional design. The research received ethical approval from the Health Research Ethics Committee (KEPK) of the Faculty of Medicine, Diponegoro University and Dr. Kariadi General Hospital Semarang, Number 16284/EC/KEPK-RSDK/2024, and research permit Number DP.04.01.D.X.2/9592/2924. The research sample consisted of 56 Coronary Heart Disease (CHD) patients treated at Dr. Kariadi Hospital Semarang during the period of December 2024 who came to Dr. Kariadi Hospital and met the following inclusion criteria: Patients with Chronic Coronary Syndrome, patients aged 18 years and older, patients who underwent coronary angiography and were found to have coronary artery stenosis, and patients who agreed to participate in the study by signing an informed consent form. Exclusion criteria were: Patients with a family history risk factor for CHD, patients cognitively unable to be interviewed, patients with liver disease, infection, and inflammatory diseases, patients who had undergone Percutaneous Coronary Intervention or Coronary Artery Bypass Graft surgery, and significant changes in dietary patterns for more than 1 year.

Venous blood samples were immediately taken from patients for laboratory examination of LDL, HDL, Triglycerides, HbA1c, oxLDL, and hs-CRP. The blood was centrifuged and stored at -20°C until used. Levels of LDL, HDL, triglycerides, hs-CRP (in mg/dL) and oxLDL (in ng/mL) as well as HbA1c (in %) were directly examined from venous blood the ELISA method with Abott reagent at the GAKY laboratory of Diponegoro University, Semarang. Subsequently, interviews were conducted by bachelor-qualified nutritionists (S1) using a validated Semiquantitative Food Frequency Questionnaire (SQ FFQ) and food models, with units in grams per day (g/day), to determine the intake of simple carbohydrates and trans fats. Types of simple carbohydrates and trans fats were differentiated based on their processing method (recorded in the SQ FFQ); namely, simple carbohydrates are refined carbohydrates that have undergone processing, such as bread, noodles, pasta, glutinous rice, sugar, syrup, and ice cream. Trans fats are foods that are deep-fried, such as french fries, fried tofu, and various other fried foods. The relationship between simple carbohydrates and trans fats and the severity of coronary artery stenosis was analyzed using Spearman and Pearson tests. Confounding variables, including age, gender, hypertension status, DM status, dyslipidemia status, smoking status, physical activity level (yes/no), statin consumption, and antidiabetic drug consumption, were analyzed using multiple linear regression tests.[7,8]

RESULTS

Sample collection was conducted using consecutive sampling from December 2024. The study subjects were patients with chronic coronary syndrome who underwent coronary angiography and met the inclusion criteria at Kariadi Hospital Semarang. A total of 62 study subjects underwent coronary angiography procedures in December 2024, and there were 6 subjects who dropped out because their coronary angiography results were normal. The 56 study subjects who met the inclusion criteria underwent a questionnaire survey using the SQ-FFQ method, then had laboratory examinations for HDL, LDL, Triglycerides, HbA1C, hs-CRP, and oxLDL, and then their Gensini score was assessed from the results of the coronary angiography they had undergone. These study subjects exhibited diverse baseline characteristics with statistically significant differences, such as age, gender, socioeconomic status, physical activity level, BMI (Body Mass Index), routine medication consumption, simple carbohydrate intake, trans fat intake, energy intake, HDL levels, LDL levels, Triglyceride levels, HbA1C levels, hs-CRP levels, oxLDL levels, and Gensini score.

In Table 1 basic characteristics, the majority of study subjects were male (43 subjects, 76.8%), compared to females (13 subjects, 23.2%). The mean age of the subjects was 56.9 ± 10.21 years, with a median age of 57 years (range 37–82 years). The most common risk factor found was hypertension, experienced by 28 subjects (50.0%), followed by a history of being ex-smokers in 25 subjects (44.6%), compared to current smokers (6 subjects, 10.7%), dyslipidemia in 19 subjects (33.9%), and diabetes mellitus in 17 subjects (30.4%). The most frequently encountered highest level of education was high school (SMA), accounting for 28 subjects (50.0%), and the majority of subjects came from a middle socioeconomic level (39 subjects, 69.6%).

In anthropometric measurements, the mean body weight of the subjects was 69.8 ± 12.75 kg, mean height was 1.6 ± 0.07 meters, and the mean Body Mass Index (BMI) was 26.1 ± 4.19 kg/m². Most subjects used moderate-intensity statins, predominantly atorvastatin 20mg/day (31 subjects, 55.4%), and only a small proportion consumed anti-diabetic drugs (16 subjects, 28.6%). Additionally, the proportion of subjects reporting sufficient physical activity of 30 minutes per day, 5 times a week, was also low, at only 17 subjects (30.4%). The mean simple carbohydrate intake was only 65.5 ± 28.81 grams/day, equivalent to 262.2 ± 115.24 kcal/day. This is still below the WHO recommendation that total carbohydrate intake per day should be 40–65% of total daily calorie needs, and simple carbohydrate intake should be 10% of total daily calorie needs. Meanwhile, the mean trans fat intake was 2.1 ± 6.41 grams/day, equivalent to 25.9 ± 57.69 kcal/day, exceeding the recommended limit for trans fat intake, which is 1% of total daily calories.

In the Table 2 examines the relationship between various confounding factors and the Gensini Score, indicates that none of the tested variables demonstrated a statistically significant association. Factors such as gender, hypertension, smoking status, OAD use, and physical activity all produced *p*-values well above the standard significance threshold of $p<0.05$. It is particularly noteworthy that despite a substantial numerical difference in the mean Gensini Score between statin consumers (78.32±42.95) and non-consumers (36.33±27.79), the result did not achieve statistical significance ($p=0.102$). This lack of significance, especially in the statin group, may be attributed to high variability within the groups (as evidenced by large standard deviations) or a potentially underpowered study sample. Furthermore, the stated use of Spearman's correlation is an unconventional methodological choice for comparing a continuous variable between two distinct groups, where a Mann-Whitney U test would typically be more appropriate. Therefore, based on this analysis, it must be concluded that no significant relationship was found between the investigated confounding factors and the Gensini Score in this study population.

In the Table 3 the results of testing confounding variables against the Gensini score showed *p*-values >0.05. Thus, it can be concluded that these confounding variables did not have a significant relationship with the Gensini score. However, statin consumption and gender approached *p*-values < 0.25, but they could not be carried forward to multivariate analysis because they are categorical variables.

In the Table 4 simple carbohydrate intake, the *p*-value was 0.001 ($p < 0.05$) and the r-value was 0.420.

TABLE 1
Baseline Characteristic

Variable	Frequency (n=56)	%	Mean ± SD	Median (min – max)
Gender				
Men	43	76.8		
Women	13	23.2		
Age			56.9 ± 10.21	57 (37 – 82)
Risk Factor				
Hipertension	28	50.0		
Ex-smoker	25	44.6		
Smoker	6	10.7		
DM	17	30.4		
Dyslipidemia	19	33.9		
Menopause	4	7.1		
FH CAD	5	8.9		
Education				
SD	3	5.4		
SMP	6	10.7		
SMA	28	50.0		
S1	12	21.4		
S2	7	12.5		
Social Economic				
Low	8	14.3		
Moderate	39	69.6		
High	9	16.1		
Weight			69.7 ± 12.7	68.5 (42 – 97)
Height			1.6 ± 0.07	1.65 (1.48 – 1.85)
BMI			26.1 ± 4.19	25.92 (17.48 – 37.78)
Statin				
Non-Consumed	3	5.4		
Consumed	53	94.6		
Oral Anti-Diabetic				
Consumed	16	28.6		
Non-Consumed	40	71.4		
Physical Activity				
Yes	17	30.4		
No	39	69.6		

TABLE 1. *Continued*

Variable	Frequency (n=56)	%	Mean ± SD	Median (min – max)
Simple Cardohydrates (ccal/day)			262.2 ± 115.24	282.8 (2.0 – 565.6)
Complex Carbohydrates (ccal/day)			887.68 ± 418.16	838.8 (202.4 – 2168.8)
Total Carbohydrates (ccal/day)			1068.64 ± 394.64	976.2 (408.4 – 2204.8)
Trans Fat (ccal/day)			25.9 ± 57.69	3.8 (2.7 – 424.8)
Total Fat (ccal/day)			1079.64 ± 540.18	956.7 (396 – 2846.7)
Saturated Fat (ccal/day)			556.74 ± 287.55	489.6 (209.7 – 1548.9)
Unsaturated Fat (ccal/day)			429.12 ± 219.42	365.4 (158.4 – 1094.4)
Total Fat (ccal/day)			1079.64 ± 540.18	956.7 (396 – 2846.7)
Protein (ccal/day)			376.21 ± 118.52	312 (30 – 612.8)
Fiber (ccal/day)			42.7 ± 30.5	43.8 (19.6 – 85.8)
Energi (ccal/day)			2508.1 ± 978.35	2288.2 (1076.9 – 4813.5)
HDL (mg/dl)			38.9 ± 10.84	37.5 (18 – 86)
LDL (mg/dl)			101.9 ± 39.31	94 (27 – 195)
Trigiseride (mg/dl)			130.2 ± 105.69	103 (19 – 684)
HbA1C (%)			6.3 ± 1.25 (%)	5.8 (4.8 – 10.6)
Hs-CRP (mg/L)			5.4 ± 4.47	4.25 (0.40 – 15.60)
OxLDL (ng/ml)			74.5 ± 17.97	75.36 (24.88 – 109.01)
Gensini Score			76.1 ± 43.17	78 (8 – 164)

Information: DM : Diabetes Melitus; FH CAD : *Family History Coronary Artery Disease;* SD : Sekolah Dasar; SMP : Sekolah Menengah Pertama; SMA : Sekolah Menengah Atas; S1 : Strata-1; S2 : Strata-2; BMI : Body Mass Index; OAD : Oral Anti-Diabetic

Thus, it can be concluded that there is a significant relationship between simple carbohydrate intake and the Gensini score, with a moderate positive direction and strength. Trans fat intake, the *p*-value was 0.034 ($p < 0.05$) and the r-value was 0.283. Thus, it can be concluded that there is a significant relationship between trans fat intake and the Gensini score, with a weak positive direction and strength. LDL levels, the *p*-value was 0.044 ($p < 0.05$) and the r-value was 0.270. Thus, it can be concluded that there is a significant relationship between LDL levels and the Gensini score, with a weak positive direction and strength.Hs-CRP levels, the *p*-value was 0.020 ($p < 0.05$) and the r-value was 0.310. Thus, it can be concluded that there is a significant relationship between hs-CRP levels and the Gensini score, with a weak positive direction and strength.

OxLDL levels, the *p*-value was 0.007 ($p < 0.05$) and the r-value was 0.359. Thus, it can be concluded that there is a significant relationship between OxLDL levels and the Gensini score, with a weak positive direction and strength. Other variables in relation to the Gensini score, using the correlation test, *p*-values >0.05 were obtained; thus, it can be concluded that there was no significant relationship.

In the Table 5 the results of the Spearman's correlation test of the relationship between the amount of simple carbohydrate intake and triglyceride levels obtained a *p* value = 0.588 ($p > 0.05$) so it can be concluded that there is no significant relationship. The results of the Spearman's correlation test of the relationship between the amount of simple carbohydrate intake and HbA1C levels obtained a *p* value = 0.021 ($p < 0.05$) and r value = 0.307 (0.2 – <0.4) so it can be concluded that there is a significant relationship with the direction and strength of the relationship being weakly positive. The results of the test of the relationship between carbohydrates and hs-CRP using the Spearman's correlation test obtained a *p* value = 0.053 ($p > 0.05$) so it can be concluded that the amount of simple carbohydrate intake with hs-CRP has no significant relationship, but the amount of simple carbohydrate intake with OxLDL using the Pearson correlation test obtained a *p* value = 0.014 ($p < 0.05$) and

TABLE 2
Relation Confounding Factor with Gensini Score

Confounding Variable	**Gensini Score**	***p***
Gender		0.155£
Male	80.6 ± 45.83	
Female	61.1 ± 29.52	
Hypertension		0.482£
Yes	71.96 ± 39.72	
No	80.18 ± 46.73	
Smoker		0.909£
Yes	78.00 ± 48.05	
No	75.84 ± 43.01	
Statin		0.102£
Non-Consumed	36.33 ± 27.79	
Consumed	78.32 ± 42.95	
OAD		0.771£
Consumed	73.4 ± 49.09	
Non-Consumed	77.2 ± 41.20	
Physical Activity		0.858£
Yes	64.6 ± 26.55	
No	80.5 ± 44.96	

Information : £Correlation Spearman's

TABLE 3
Relation Confounding Factor with Age and BMI on Gensini Score

Variabel Perancu	**Gensini Score**	
	r	***p***
Age	0.093	0.494¶
BMI	0.145	0.288¶

r value = 0.328 (0.2 - <0.4) so it can be concluded that the amount of carbohydrate intake with oxLDL has a significant relationship with the direction and strength of the relationship being weakly positive.

In the Table 6 The results of the Spearman's correlation test of the relationship between the amount of trans fat intake and HDL levels obtained a p value = 0.299 ($p > 0.05$) so it can be concluded that there is no significant relationship. The results of the Spearman's correlation test of the relationship between the amount of fat intake and LDL levels obtained a p value = 0.017 ($p < 0.05$) r value = 0.318 (0.2 – <0.4) so it can be concluded that the amount of trans fat intake and LDL levels has a significant relationship with the direction and strength of the relationship being weakly positive. The results of the Spearman's correlation test of the relationship between the amount of trans fat intake and triglyceride levels obtained a p value = 0.410 ($p > 0.05$) so it can be concluded that there is no significant relationship. The results of the test of the relationship between fat and hs-CRP using the Spearman's correlation test obtained a p value = 0.053 ($p > 0.05$) so it can be concluded that there is no significant relationship between fat and hs-CRP, in OxLDL using the Spearman's correlation obtained a p value = 0.954

TABLE 4
Relation Variable with with Gensini Score

Variable	Gensini Score r	Gensini Score p
Simple Carbohydrates	0.420	0.001¶*
Trans Fat	0.283	0.034£*
Energy	0.111	0.413£
HDL	-0.035	0.795£
LDL	0.270	0.044¶*
Trigiseride	0.028	0.839£
HbA1C	0.024	0.861£
Hs-CRP	0.310	0.020£*
OxLDL	0.359	0.007¶*

Information : *Significant (p < 0.05); ¶Correlation Pearson; £Correlation Spearman's

TABLE 5
Relation Simple Carbohydrates with Trigliseride, HbA1C, hs-CRP and oxLDL

Variable	Simple Carbohydrates r	Simple Carbohydrates p
Trigliseride	0.129	0.344£
HbA1C	0.058	0.021£*
hs-CRP	0.144	0.053£
OxLDL	0.022	0.014¶*

Information : Normal (p > 0.05); *Significant (p < 0,05); ¶Correlation Pearson; £Correlation Spearman's

TABLE 6
Relation Trans Fat with HDL, LDL, Trigliseride, hs-CRP and oxLDL

Variable	Trans Fat r	Trans Fat p
HDL	-0.141	0.299£
LDL	0.318	0.017£*
Trigliseride	0.112	0.410£
hs-CRP	0.241	0.074£
OxLDL	0.008	0.954£

Information : Normal (p > 0.05); *positif (p < 0.05); £Correlation Spearman's

(p > 0.05) so it can be concluded that there is no significant relationship between fat and OxLDL.

In the Table 7 the results of the correlation test of the variables of the amount of simple carbohydrate intake, the amount of trans fat intake, LDL levels, hs-CRP levels and oxLDL levels meet the requirements for multivariate testing using multiple linear regression tests. The results of the multiple linear regression test on the amount of simple carbohydrate intake obtained a p value = 0.004 (p <0.05) so it can be concluded that the

TABLE 7
Multivariate Results with Gensini Score

Variable	Beta	p
Simple Carbohydrates	0.347	0.004*
Trans Fat	0.357	0.002*
LDL	0.122	0.304
Hs-CRP	0.056	0.663
OxLDL	0.280	0.019*

Information : *Significant (p < 0.05)

amount of simple carbohydrate intake is a factor that influences the Gensini score. On the amount of trans fat intake, the p value = 0.002 (p <0.05) was obtained. On OxLDL levels, the p value = 0.019 (p <0.05) was obtained so it can be concluded that the amount of simple carbohydrate intake, trans fat, and oxLDL levels are factors that influence the Gensini score.

DISCCUSION

This research comprehensively investigates various factors potentially influencing the severity of Coronary Heart Disease (CHD) as measured by the Gensini score and their relationship with various important biomarkers. The primary focus is on the role of nutritional intake, specifically simple carbohydrates and trans fats, alongside an analysis of confounding variables and the methodological limitations of the study.[12,13]

The Influence of Simple Carbohydrate Intake on Gensini Score and Other Biomarkers In the demographic context, this study found that the majority of CHD patients were around 56 years old, a finding consistent with previous research that underscores the role of the aging process in the decline of normal tissue function and structure. Furthermore, it was emphasized that dietary patterns dominated by simple carbohydrates, such as those found in sweet snacks, corn syrup, and added sugars, significantly increase the risk of CHD events. Specifically, the results of Pearson correlation analysis in this study indicated a significant positive relationship with moderate strength (p=0.001; r=0.420) between the amount of simple carbohydrate intake and the Gensini score. This finding is supported by a previous meta-analysis by Jo U *et al*., which indicated that individuals with the highest carbohydrate consumption have a 1.15 times higher risk of cardiovascular disease, particularly in the context of atherosclerosis development. The average simple carbohydrate intake of the study subjects was 45.24 ± 28.81 grams/day (equivalent to 262.2 ± 115.24 kcal/day), accounting for approximately 10% of the total daily energy intake. This figure was considered to have reached or even exceeded the upper limit of the low simple carbohydrate dietary proportion recommended for CHD prevention (i.e., a maximum of 10% of total daily calories). The nature of simple or refined carbohydrates having undergone processing, lost fiber and micronutrients, and possessing smaller moleculescauses them to be absorbed more quickly, metabolized faster, and potentially trigger detrimental spikes in plasma glucose levels. Regarding other biomarkers, this study found no significant relationship between simple carbohydrate intake and levels of triglycerides, hs-CRP, or oxLDL. However, a significant positive relationship, albeit with very weak strength (p=0.021; r=0.058), was detected between simple carbohydrate intake and HbA1c levels. This finding is relevant because other research, such as by Xiao Jiao *et al*., has linked higher HbA1c levels with increased CHD severity based on the Gensini score, where hyperglycemia is known to damage the cardiovascular system and accelerate the atherosclerotic process through various mechanisms, including endothelial cell damage and oxidative stress.[12,13]

The Role of Trans Fat Intake on Gensini Score, Lipid Profile, and Inflammation Furthermore, this study also revealed a significant positive correlation, though with weak strength (p=0.034; r=0.283), between the amount of trans fat intake and the Gensini score. The consistency of this finding with previous research, such as by Li-Yun *et al*. and Samia Hadj *et al*., reinforces the idea that trans fat intake can serve as a biomarker predicting the severity of coronary artery lesions and correlates with inflammatory parameters and oxidative stress. The average trans fat intake in this study was recorded at 2.10 ± 6.41 grams/day (equivalent to 25.9 ± 57.69 kcal/day). Considering the subjects' average energy intake of 2508.12 ± 978.35 kcal/day, this trans fat intake (approximately 1% of total energy) was still within the limits recommended by the World Health Organization for adults, which is less than 1% of total daily energy intake. In relation to specific biomarkers, a significant positive relationship with weak strength was found between trans fat intake and LDL levels (p=0.017;

r=0.318). Furthermore, trans fat intake also showed a significant relationship with hs-CRP, an important inflammatory marker. Nevertheless, no significant relationship was found between trans fat intake and levels of HDL, triglycerides, or oxLDL. This difference in results compared to some other studies, such as by Zapolska *et al*., could possibly be explained by the relatively low level of trans fat intake (less than 1% of total energy) in this study's subject population.[15–17] Analysis of Confounding Variables and Their Influence on the Gensini Score This study also discussed various confounding variables that can influence the interpretation of the relationship between risk factors and the Gensini score. It was explained that confounding variables may not always show a direct relationship with the dependent variable for various reasons, including the presence of mediators, very small effects, or errors in measurement and identification. The average age of the subjects (56 years) and the predominance of males (76.8%) in this study sample align with the general demographic profile of CHD patients, where men are known to be more susceptible to atherosclerosis progression before menopause. Risk factors like hypertension, although theoretically significant, might not have shown a strong correlation with the Gensini score in this study due to the use of antihypertensive medication by a majority of the subjects, potentially modifying its effects. One of the most prominent confounding variables was statin consumption. Consistent with major studies like PARADIGM, JUPITER, and REVERSAL, statin use has been proven to be associated with a reduction in the progression rate of coronary atherosclerosis and can lower levels of inflammatory biomarkers (hs-CRP) and lipids (LDL, oxLDL). Therefore, statin consumption can be a significant co-founding factor in the analysis of the relationship between diet and atherosclerotic biomarkers. Similarly, the use of antidiabetic drugs has the potential to influence oxLDL levels, given that these medications are known to have suppressive effects on oxLDL and related inflammatory processes in diabetic patients. The relatively low level of physical activity reported by the study subjects was also noted, considering the benefits of physical activity in improving coronary blood flow and endothelial function in CHD patients. Conversely, fiber intake showed interesting results, with a significant relationship found between higher fiber intake and lower levels of hs-CRP and oxLDL, supporting the protective role of fiber in the atherosclerotic process.[18–20]

Methodological Limitations of the Research Finally, this study transparently acknowledged several methodological limitations. The use of the Semiquantitative Food Frequency Questionnaire (SQ-FFQ), which relies heavily on the subjects' recall memory regarding their simple carbohydrate and trans fat intake habits over a specific period, has the potential to introduce bias in data collection. Additionally, there was a risk of flat slope syndrome, a tendency for research subjects to provide answers that do not entirely reflect reality, for instance, by under-reporting their intake, which could affect the accuracy of the dietary intake data obtained and the overall interpretation of the research findings.[7]

Thus, this research provides an important contribution to understanding the complex interactions between diet, particularly simple carbohydrate and trans fat intake, and the severity of CHD and related biomarkers, while also considering the influence of confounding variables and acknowledging the inherent limitations in the methodology employed.[12,13]

CONCLUSION

This research presents significant findings that deepen our understanding of how daily dietary patterns directly contribute to heart health. Convincingly, the study reveals a strong relationship between the intake amount of simple carbohydrates and trans fats and the severity of coronary artery stenosis, objectively measured by the Gensini score. To ensure the accuracy and depth of data in similar future investigations, this research offers an important suggestion that the dietary intake interview process be conducted more personally and gradually, thereby building a better rapport with research subjects and yielding more valid and reliable dietary information.

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CONFLICT OF INTEREST

The author has no conflicts of interest that could affect the results or interpretation in this report.

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