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Research Article

Association between mustard oil consumption and thrombocytopenia: a case-control study in Bangladesh

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Abstract

Background and objectives: Mustard oil, a common ingredient in South Asian cuisine, has been associated with both culinary appeal and potential health benefits. While studies suggest its role in reducing the risk of ischemic heart disease, concerns arise due to the presence of erucic acid, which has been linked to adverse cardiovascular effects and thrombocytopenia. This case-control study aimed to investigate the association between mustard oil consumption and thrombocytopenia in the Bangladeshi population.

Materials and methods: Consecutive patients diagnosed with thrombocytopenia (platelet count < 150000/µL) were enrolled as cases, while controls were selected as the next consecutive patients with normal platelet counts, regardless of demographic characteristics or disease status. Data on demography, clinical variables and mustard oil consumption were collected from medical records and face-to-face interviews.

Results: Seventy-six participants were included in the study of which 38 belonged to case and 38 to control groups. The mean age of the individuals in control and case groups was 57.5 and 58.2 years respectively (p = 0.808). Notably, 83.3% of cases reported using mustard oil compared to 28.3% of controls (p<0.001). Cases exhibited significantly (p < 0.001) lower platelet counts (114,789 ± 24,453 /µL) compared to controls (278,211 ± 84,595 /µL). Male gender and the use of mustard oil in cooking were identified as predictors of thrombocytopenia. No bleeding symptoms were observed, raising questions about the clinical significance of mustard oil-associated thrombocytopenia.

Conclusion: The study underscores the need for further research to elucidate the complex relationship between mustard oil consumption, erucic acid, and thrombocytopenia, emphasizing the importance of dietary habits in health outcomes.

Introduction

Mustard oil has long been a culinary staple in South Asian cuisine, valued not only for its distinctive flavour but also for its perceived health benefits [1]. While limited human clinical studies exist, research findings reveal a significant reduction in the risk of

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ischemic heart disease (IHD) associated with the consumption of mustard oil, particularly when compared to other cooking oils like sunflower oil [2]. Its unique fatty acid profile, characterized by low saturated fats and high alpha-linolenic acid (ALA), contributes to its cardioprotective effects by lowering LDL cholesterol levels and reducing the risk of ischemic heart disease. Additionally, its stability during cooking ensures the preservation of its nutritional integrity, making it a preferred choice for promoting heart health in Indian dietary practices [3].

However, the presence of erucic acid in mustard oil has raised concerns regarding its cardiovascular safety, prompting regulatory scrutiny and public debate [4]. Animal studies have indeed demonstrated potential adverse effects of erucic acid on heart health, such as myocardial lipidosis and cardiac lesions [5,6]. Additionally, erucic acid has been associated with thrombocytopenia in patients, particularly in the context of using Lorenzo's Oil, which contains high concentrations of erucic acid, for the treatment of X-linked adrenoleukodystrophy (X-ALD) [7,8]. Erucic acid, a monounsaturated omega-9 fatty acid, is present in varying concentrations across different cooking oils, with mustard oil and rapeseed oil (canola oil) being notable sources. Mustard oil, derived from seeds of the mustard family (Brassicaceae), typically contains around 41.8% erucic acid in commercial varieties, while traditional ghani mustard oil (extracted by using pestle and mortar) may have a slightly higher concentration, approximately 51.98% [9]. Rapeseed oil, commonly known as canola oil, initially had erucic acid levels ranging from 30% to 60% of total fatty acids, but modern cultivars have significantly lower levels, typically less than 2% [10]. Soybean oil and sunflower oil, commonly used in cooking, generally have negligible levels of erucic acid, making them safe options for consumption. While erucic acid was initially considered cardiotoxic, recent research has unveiled its potential medicinal properties. Despite its controversial history, erucic acid has been associated with antibacterial, antiviral, anti-inflammatory, and neuroprotective effects, suggesting a nuanced understanding of its health implications [11-14].

Amidst these discussions, anecdotal evidence suggests a possible link between mustard oil consumption and thrombocytopenia, prompting further investigation. This case-control study aims to explore whether mustard oil poses a risk factor for thrombocytopenia in the Bangladeshi population.

Methods

The case-control study was conducted from December 2023 to March 2024 at a tertiary care hospital in Dhaka city. Informed verbal consent was obtained from each patient prior to the enrolment in the study. Consecutive patient diagnosed with thrombocytopenia (platelet count less than 150000/µL) [15] was enrolled as case, while control was selected as the next consecutive patient with normal platelet counts following each case, regardless of demographic characteristics or disease status. Data on patients' demography, medical history, mustard oil consumption, complete blood count (CBC) results, and relevant clinical variables were collected from medical records and face-to-face interviews. Mustard oil consumption was defined as the habitual use of mustard oil as the primary cooking oil in participants' daily dietary practices. Statistical analysis involved logistic regression to assess the association between thrombocytopenia and potential risk factors or covariates. Unmatched controls were used to uncover unknown confounders, with logistic regression employed to minimize associated bias.

Results

In this case-control study, the total study population comprised 76 participants, evenly distributed between the case and control groups, each consisting of 38 subjects. The mean age of the study population was 57.9 years, with controls and cases having mean age of 57.5 and 58.2 years, respectively. Statistical analysis revealed no significant difference in age between the control and case groups (p =0.808, mean difference -0.658, 95% CI [-6.023, 4.707]). The Table-1 presents the distribution of baseline characteristics between the control and case groups. Significant differences were observed in mustard oil consumption

Table-1: *Characteristics of control and case groups*

Variable	Control n (%))	Case n (%)	Total n (%))	Pearson Chi-Square
Sex				
Female	25 (65.8)	14 (36.8)	39 (51.3)	*p* =.012
Male	13 (34.2)	24 (63.2)	37 (48.7)	
Mustard oil consumption				
No	33 (86.8)	13 (34.2)	46 (60.5)	*p* <.001
Yes	5 (13.2)	25 (65.8)	30 (39.5)	
CKD				
No	6 (15.8)	6 (15.8)	12 (15.8)	*p* =.866
Yes	32 (84.2)	32 (84.2)	64 (84.2)	
DM				
No	6 (15.8)	7 (18.4)	13 (17.1)	*p* = .244
Yes	32 (84.2)	31 (81.6)	63 (82.9)	
Clopidogrel				
No	34 (89.5)	32 (84.2)	66 (86.8)	*p* = .971
Yes	4 (10.5)	6 (15.8)	10 (13.2)	
Aspirin				
No	33 (86.8)	32 (84.2)	65 (85.5)	*p* = .371
Yes	5 (13.2)	6 (15.8)	11 (14.5)	
Bleeding				
No	38 (100.0)	38 (100.0)	7 6(100.0)	--
Yes	0(0)	0(0)	0(0)	

Note: CKD: chronic kidney disease; DM: diabetes mellitus

between the two groups (p<0.001). Notably, 83.3% of cases reported using mustard oil compared to 28.3% of controls, suggesting a potential association between mustard oil consumption and thrombocytopenia. No subjects exhibited any signs of bleeding within the study population, observed in both the control and case groups.

Table-2 provides detailed information on quantitative variables, including age, platelet count, haemoglobin level, and serum creatinine level, for both control and case groups. While no significant differences were found in age, haemoglobin level, or serum creatinine level between the two groups, a substantial disparity in platelet counts was evident (p< 0.001). Cases exhibited significantly (p < 0.001) lower platelet counts (114,789 ± 24,453 /µL) compared to controls (278,211 ± 84,595 /µL).

In subsequent linear regression analysis, we examined the relationship between platelet concentration (PC) and two potential predictor

Table-2: *Difference in variables between control and case groups*

Variable	Control (n = 38) Mean ± SD	Case (n =38) Mean ± SD	*p*-value*
Age (years)	57.53 ± 11.23	58.18 ± 12.22	0.808
Platelet Count (x /µL)	278,211 ± 84,595	114,789 ± 24,453	< 0.001
Haemoglobin (g/dL)	10.83 ± 1.73	11.19 ± 2.17	0.428
Creatinine (mg/dL)	2.87 ± 2.47	3.05 ± 1.94	0.740

*Note: *Calculated by student's t test*

variables: age and creatinine levels (Table-3). The results revealed that neither age (β = -0.184, p = 0.069) nor creatinine levels (β = -0.146, p = 0.143) showed a statistically significant association with platelet concentration, whereas a negative relationship was found between mustard oil consumption and platelet count.

We conducted a logistic regression analysis to explore the associations between various factors and the presence of thrombocytopenia. Thrombocytopenia served as the dependent variable. The initial logistic regression model (Table-4) included several potential predictors of thrombocytopenia, such as sex, age, mustard oil use, creatinine level, CKD, DM, clopidogrel use, and aspirin use. Among these variables, sex (p = 0.028) and mustard oil consumption (p< 0.001) emerged as significant predictors of thrombocytopenia. Age, creatinine level, CKD, DM, clopidogrel use, and aspirin use did not show statistically significant associations with thrombocytopenia in this model.

In the reduced logistic regression model (Table-5), only sex and mustard oil consumption were retained as significant predictors of thrombocytopenia. Sex (female to male) exhibited a significant association with an increased risk of thrombocytopenia (p = 0.049, Exp(B) = 3.023, 95% CI [1.003, 9.110]), while mustard oil consumption showed a substantial risk elevation (p<0.001, Exp(B) = 12.134, 95% CI [3.694, 39.856]). Here the logistic regression model explains the 40.5% of the variation in the outcome.

Table-3: *Regression coefficients for platelet count prediction*

Variable	B	β	*p*-value	95.0% CI for B
Constant	376221.08		<0.001	[261624.74, 490817.43]
Age	-1722.55	-0.184	0.069	[-3580.77, 135.66]
Creatinine	-6920.18	-0.146	0.143	[-16234.85, 2394.50]
Sex	-31177.66	-0.150	0.143	[-73167.68, 10812.37]
Mustard oil consumption	-107521.53	-0.511	<0.001	[-150023.52, -65019.53]

Table-4: *Logistic regression analysis results for the associations between various factors and thrombocytopenia (Model 1: Full Model)*

Variable	B	*p* value	Exp(B)	95% C.I. for Exp(B)
Sex*	1.400	.028	4.054	[1.161, 14.150]
Age	0.015	.585	1.015	[0.962, 1.071]
Mustard oil consumption*	2.854	<.001	17.351	[4.369, 68.905]
Creatinine	0.096	.505	1.101	[0.830, 1.459]
CKD	0.089	.925	1.093	[0.170, 7.012]
DM	0.651	.487	1.917	[0.306, 11.988]
Clopidogrel	-0.374	.710	0.688	[0.096, 4.949]
Aspirin	0.612	.473	1.844	[0.346, 9.829]
Constant	-3.575	.077	0.028	

*Note: *Reference group: Female; no consumption of mustard oil.*

Table-5: *Logistic regression analysis results for the associations between only significant variables (sex and mustard oil) and thrombocytopenia (Model 2: Reduced Model)*

Variable	B	*p* value	Exp(B)	95% C.I. for Exp(B)
Sex*	1.106	0.049	3.023	[1.003, 9.110]
Mustard oil consumption	2.496	<0.001	12.134	[3.694, 39.856]
Constant	-1.452	<0.001	0.234	

*Note: * Reference group: Female*

Discussion

The findings of this study suggest a significant association between mustard oil consumption and thrombocytopenia in the Bangladeshi population. Logistic regression analysis revealed that male sex and mustard oil use were significant predictors of thrombocytopenia. Prior research has implicated erucic acid, present in mustard oil, in thrombocytopenia development [7,8]. However, our study observed no bleeding symptoms among thrombocytopenic patients, and haemoglobin levels did not differ significantly between groups, raising questions about the clinical significance of mustard oil-associated thrombocytopenia and underscoring the need for further investigation.

It is crucial to interpret these findings within the broader context of mustard oil's health effects and erucic acid's physiological role. While erucic acid has been implicated in thrombocytopenia development, particularly in the context of interventions like Lorenzo's oil, its overall impact on platelet function remains complex and multifaceted [16]. Further, the geographical distribution of constitutional macrothrombocytopenia overlaps significantly with areas where mustard oil consumption is prevalent in the Indian subcontinent [17,18]. This intriguing correlation raises the question: could a portion of individuals diagnosed with constitutional macrothrombocytopenia actually be experiencing thrombocytopenia as a result of mustard oil consumption? While animal studies have suggested potential adverse effects on heart health, recent research has underscored erucic acid's therapeutic potential across various medical applications. This duality necessitates a nuanced understanding of erucic acid's effects, considering both its potential risks and benefits.

Limitations of this study include its retrospective nature, small sample size, and the absence of erucic acid blood level measurements. Future research should address these limitations and explore the underlying mechanisms of mustard oil's effects on platelet counts comprehensively.

In conclusion, this study highlights the potential link between mustard oil consumption and thrombocytopenia in Bangladeshi population. While further research is needed to supplement these findings and elucidate the clinical implications, these results underscore the importance of dietary habits in thrombocytopenia development. Public health efforts should focus on raising awareness about the potential risks associated with mustard oil consumption and promoting healthier dietary choices.

Competing interest

The author declares no conflict of interest.

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