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RESEARCH ARTICLE

ASSOCIATION BETWEEN MUSTARD DERIVATIVES CONSUMPTION AND INCIDENCE OF HEADACHE:A CROSS-SECTIONAL STUDY

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Abstract

Background: Headache disorders are among the most common neurological conditions in the world and, in some individuals, are often associated with dietary factors. Mustard and its derivatives are condiments that contain bioactive compounds such as allyl isothiocyanate and glucosinolate derivatives, which affect vascular function and neurochemical signalling. Despite its presence in everyday diets, the potential role of mustard as a trigger for headache is understudied. Therefore, this study aims to explore whether mustard—in its various forms, including seeds, pastes, and sauces—may act as a dietary factor associated with headache occurrence.

Methods: This study aimed to 1) investigate the incidence of headache after consumption of mustard and 2) determine whether an association exists between frequency of mustard consumption and development of a headache among adults. A cross-sectional observational study was performed including 112 adults. The data were collected through a structured questionnaire that assessed demographic characteristics, frequency and type of mustard use, occurrence of headache after consuming mustard, latency between consumption and development of symptoms and other potential dietary triggers. The main outcome was self-reported headache after mustard. Descriptive statistics were obtained, and the relationship between mustard intake frequency and headache incidence was examined using the Chi-square test. Multivariate logistic regression was used to adjust for potential confounders, such as age, sex and other dietary triggers.

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Results: Overall, participants were aged 35 ± 10 years with a total of 52% females and 48% males. The majority of participants were occasional mustard consumers (62%), 22% and 16% were frequent and rare mustard consumers, respectively. Forty-one (36.6%) subjects reported headache after using mustard. Frequent mustard consumers (62.5%) had a higher proportion of headaches than occasional (34.2%) and rare consumers (11.2%) ($p = 0.04$). However, multivariate logistic regression analysis revealed that this association lost statistical significance ($p > 0.05$) after adjustment for other dietetic triggers and demographic variables. Patients with headaches reported that the most common type of headache was migraine-like (51%), followed by sinus-type headaches (19%) and unspecified headaches (30%). The most typical time for headache onset was 2–4 hours after eating mustard.

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Conclusion: On this study the relationship between the consumption of high amount of mustard and the occurrence of headache was explored. This study explain that the correlation was not maintained specially after adjustment for potential confounders and considers that the consumption of mustard is not likely consider as a cause for people with headaches at the population level. However, consumption of mustard can be act as excite factor for people susceptible to headache. Based on this, more possible studies and trials for controlled dietary challenge of consumption required to be consider and evaluated to reach for clearly picture for the potential role caused by mustard consumption and other associated diet factors in headache etiology.

Introduction:-

Neurological disorders are increasingly recognised with a headache disorders (Leonardi et al., 2024). It may consider as major causes of poor quality life and disability worldwide. (D'Amico et al., 2020). Normally, migraine and tension-type headache represent the most predominant (Burch, 2019), which have disturbing impact affecting a considerable percent of the adult population (D'Amico et al., 2020). For example, the people susceptible to migraine were cited the dietary factors as a commune factors for headache disorder. Histamine, tyramine and other biogenic amines have been implicated with triggering headaches (Durak-Dados, Michalski and Osek, 2020; Sanlier and Bektesoglu, 2021). These chemicals can affect blood vessels in the brain and neurotransmitter pathways, possibly triggering headache attacks in susceptible individuals (Frederiksen et al., 2019). Foods known to be headache triggers are aged cheese, fermented products, chocolate and some condiments (Zaeem, Zhou and Dilli, 2016). Mustard is a commonly used condiment made from mustard seeds and pervades sauces, dressings, and processed foods (Sharma et al., 2024).

A number of biologically active compounds can be found, including allyl isothiocyanate, glucosinolates and trace elements such as magnesium and selenium (Lietzow, 2021). These compounds can affect vascular regulation and inflammatory processes. On the other hand, fermentation processes used in the preparation of some mustards can also result in the production of biogenic amines such as histamine and tyramine. For example, results reported by Yu and colleagues (Yu et al., 2021) showed that *L. plantarum* and *L. brevis* can effectively reduce biogenic amines and nitrite in fermented mustard model studies. This may be associated with symptoms such as headaches and flushing. Despite widespread consumption of mustard, limited research has investigated its potential role as a dietary trigger for headache. As results, a trying to understanding or discover the correlation between the appearance of headache and mustard consumption could be act as very helpful factor in advice for individual procumbent to headaches. Therefore, this study aims to evaluate and analysis potential relationship between the appearance and extant of headache linked with consumption of the mustard among the adults.

Materials and methods:-

Study design and validation:-

To evaluate and analysis the relationship between consumption of mustard and headache extant a cross-sectional study was employed on 112 participants. Reliability of scales and validity was assessed and the results exhibited a good consistency and acceptable validity of the measurement construct. The Questionnaire was also tested carefully before conducting the study. Model adequacy was subsequently evaluated using the Hosmer–Lemeshow goodness-of-fit test, which evaluate the assessment of how well predicted probabilities align with observed results of outcomes. This study also involves dividing the sample into several groups based on predicted risk and then comparing observed versus expected event frequencies within each group. A non-significant result ($p = 0.62$) suggests no meaningful discrepancy between observed results and predicted values, and this in turn supporting a good fit of the model to the data.

Study population:-

The all participants involved in this study were enrolled from outpatient clinics as well as community-based settings. The selection of the eligible individuals involve adults aged 18 years or older who regularly consumed foods or other dietary prepared products containing mustard and were able to provide informed consent. The excluded involve all the individuals how they had a diagnosed neurological condition not related to headache or they suffer from a recent history of head injury, as well as all the individual how are unable to reliably recall their usual dietary habits.

Data collection:-

Data were collected by a structured questionnaire included demographic characteristics (age, sex, occupation), the frequency of eating mustard and type of mustard consumption (yellow, Dijon, brown and homemade). Also, other data were collected by other questionnaire like the presence of headache after preparations containing mustard use and interval between eating preparation that contains mustard and occurrence headache history migraine or chronic headache and other dietary triggers. Participants were queried if headaches appeared within 0–6 h after mustard consumption.

Outcome measures:-

The main outcome was the occurrence of headache after mustard consumption, as reported by the subjects. The secondary outcomes included headache frequency, headache severity measured using the VAS, and the association between mustard intake frequency and headache occurrence.

Statistical analysis:-

Statistical software (GraphPad Prism 10.3) was used for data analysis. For descriptive statistics mean and standard deviation or frequency were calculated. The association between mustard consumption and headache occurrence was assessed using a Chi-square test. Three logistic regression analyses were performed to identify independent predictors. A p-value < 0.05 was considered statistically significant.

Results:-**Participant characteristics:-**

The study finally included 112 subjects. Mean age was 35 ± 10 years with the study cohort consisting of 52% females and 48% males. Concerning the residency of a participant, 78% lived in urban areas and 22% were in rural areas as shown in the table 1.

Table 1: Demographic characteristics of participants.

Characteristics	Results
Age (years, mean \pm SD)	35 ± 10
Sex (female/male, %)	52/48
Residency (Urban/rural, %)	72/22

Mustard consumption patterns:-

Most participants reported consuming mustard occasionally (62%), a smaller proportion (22%) reported frequent consumption while the remaining 16% of participants reported rare consumption of mustard as shown in table 2.

Table 2: Mustard consumption patterns

Frequency of mustard consumption	n	Participants (%)
Frequent	24	22
Occasional	70	62
Rare	18	16

Association between mustard intake and headache:-

To assess the association between mustard intake and headache, participants were divided into three groups according to their frequency of mustard consumption (rare consumers, occasional consumers and frequent consumers). The self-reported frequency of headaches in relation to mustard consumption was compared between groups by means of a chi-square test (table 3). The results demonstrated that participants with frequent mustard consumption were more prone to headache than non-mustard consumers or those with infrequent intake. The number of participants who suffered from headaches after mustard intake increased linearly as increasing with amount of mustard consumption. Thus, a moderate relationship between mustard intake and extent of headache could be considered. On the other hand, the incidence of headache can be affected by a range of different lifestyle and dietary habit, therefore multivariable logistic regression to adjust for possible confounding were applied. The applied model involve other commonly reported products like chocolate, caffeinated drinks, and fermented products. Also, demographic factors, including age and sex were considered.

A statistically significant association was identified between mustard intake and the occurrence of headache ($p < 0.05$). Although this suggests that some individuals perceive mustard as a potential trigger, the relationship may be influenced by co-consumption of other dietary factors or underlying individual sensitivity to food-related triggers. Overall, the findings demonstrate a moderate but statistically significant link between mustard consumption and headache appearances, with significant increasing in prevalence associated with higher intake.

Table 3: Association between mustard intake and headache

Frequency of mustard consumption	Participants reporting headache		Participants without headache		p-value
	n	%	n	%	
Frequent consumption	15	62.5%	9	37.5%	
Occasional consumption	24	34.2%	46	65.8%	
Rare consumption	2	11.2%	16	88.8%	
Total	41	36.6%	71	63.4%	0.04*

Incidence of headache following mustard consumption:-

As shown in figure 1 the headache onset typically occurred within 2–4 hours after mustard consumption.

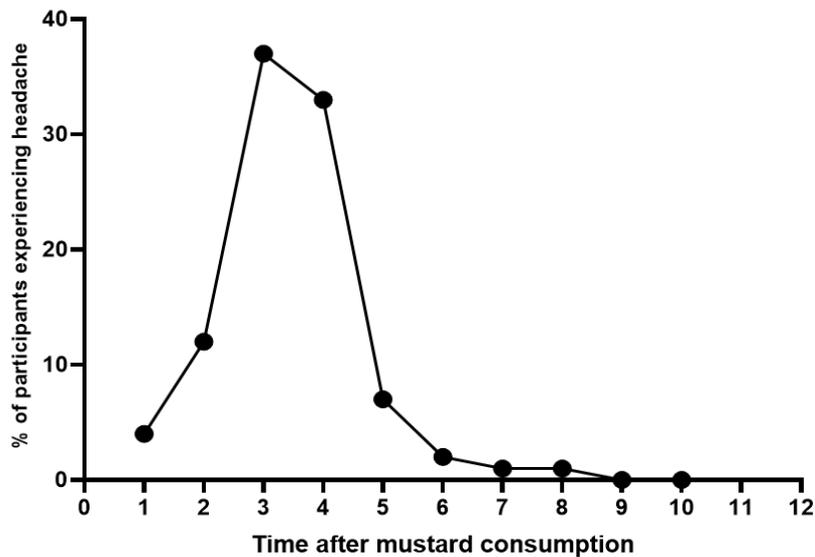


Figure 1: Incidence time-dependent of headache after mustard consumption.

Types of headaches reported after mustard consumption:-

Generally, headache clinical symptoms classified into migraine-like headache, sinus-like headache, or unspecified headache. In this study, participants who had or developing a headache after consuming of mustard asked to mentions the symptoms of headache according to the common clinical features of headache. Most of them were described a migraine-like headache which involved one side head pain combined with other symptoms like nausea or photophobia. Smaller percentage of the participants reported sinus-like headache symptoms which is similar to cold and flu symptoms such as nasal congestion and frontal pressure. However, table 4 shown that 30% of participants were unable to explain a clear classification of their symptoms and thus were classified as unspecified headache.

Table 4: Headache type reported following mustard consumption

Type of Headache	Number of Participants (n)	Percentage (%)
Migraine-like headache	21	51
Sinus-type headache	8	19
Unspecified headache	12	30
Total	41	100

Thus, in this study the migraine-like headaches could be attributed to mustard consumption. The model of headache type observed on the participants suggests that mustard is not connected with a single or specific type of headache, rather than it may play as a main trigger that could influence on the onset of headache by collection of different mechanisms such as vascular, inflammatory, and neurochemical mechanisms.

Discussion:-

The goal of the current study is to evaluate the relationship between frequency of mustard consumption and appearance of headache among adults. While there is a descriptive trend of greater reporting of headache associated with increasing mustard consumption, this relationship is non-significant when adjusting for confounding dietary and demographic variables. Such findings are suggestive of the complexity that lies in trigger and contributory foods for headache disorders, indicating a potential role for mustard as a trigger food while recognizing that such foods should not constitute universal risk factors in a dietary context. The population being studied was fairly balanced by sex (about 50% female) and included subjects with mean ages of around 35 years (Fan et al., 2023). These decades encompass the demographic peak for primary headache disorders (ie, migraine), affecting individuals aged 20 to 50 years on average (Fan et al., 2023). The balanced size of participants and similarity in both sexes gives the study more internal validity with respect to previous epidemiological studies (Dong et al., 2025) that have repeatedly shown a significantly higher prevalence of headache over-responsiveness among women compared to men for migraine and food related headaches. Fluctuations in hormonal levels—especially oestrogen—may influence trigeminovascular signalling and, in turn, increase sensitivity to dietary headache triggers.

Most participants in this study were from urban settings, which may partially account for differences in dietary habits and increased availability of processed foods containing mustard or related ingredients. In general, urban diets are often characterised by higher consumption of condiments, fermented items, and processed products, all of which may interact in complex ways to influence headache patterns through dietary cross-talk (Kébé et al., 2025). Furthermore, most respondents reported consuming mustard only occasionally, with very few indicating regular use (Grygier, 2023). This distribution is consistent with the role of mustard as a flavoring, rather than one of the major foods consumed, which is typical for dietary surveys in which information on consumption of mustard has been captured. Mustard contains several bioactive compounds including allyl isothiocyanate, sinigrin, and other glucosinolate derivatives. These compounds are responsible for the pungent taste of mustard but may also have physiological effects. Allyl isothiocyanate has been shown to activate transient receptor potential ankyrin 1 (TRPA1) receptor in sensory neurons, which are known to play a role in nociception and trigeminal nerve activation. Activation of these receptors could theoretically contribute to headache symptoms in susceptible individuals (Lietzow, 2021).

The hydrophilic glucosinolates are chemically and thermally stable. However, they can be transformed into a wide variety of breakdown products by certain β -thioglucosidases, termed myrosinases located not only in glucosinolate-forming plants but also in fungi and in bacteria associated with the gut microflora (Bhat and Vyas, 2019; Nguyen et al., 2020) as shown in figure 2. In the unadjusted analysis, there was a statistically significant association between frequency of mustard consumption and incidence of headache. Frequent mustard consumers reported greater rates of headaches than rare or occasional. This one finding may indicate an axis of exposure dose (mustard use) that corresponds to headache incidence. However, when controlling for other dietary triggers (chocolate, aged cheese, caffeine-containing beverages and fermented foods), the association lost statistical significance. This finding suggests that the association of mustard consumption with headache may be confounded by co-consumption of other well-established dietary triggers.

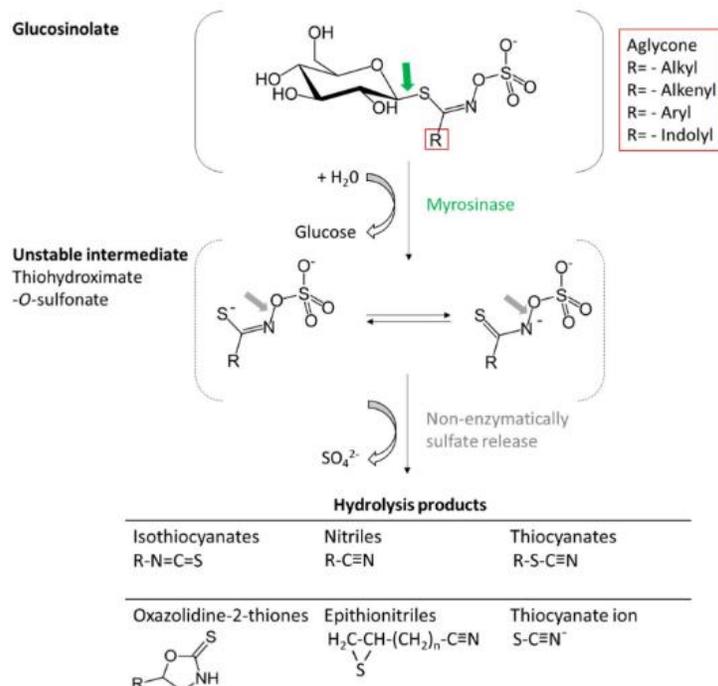


Figure 2: Enzymatic processing of glucosinolates by myrosinase into hydrolysis products in mustard.

Several different foods have been implicated in migraine triggers for susceptible subjects including tyramine-containing foods (aged cheeses) caffeine, alcohol, chocolate and fermented products. These foods can trigger headaches via a range of mechanisms, such as causing changes in cerebral vascular tone, modulating serotonin release, and stimulating trigeminal nociceptive pathways and inflammatory mediator release (Cavestro, 2025). As mustard is typically eaten with other food types, including processed meats and sandwiches, or fast foods, it can be assumed that this association represents an overall diet rather than a direct causal relationship between the mustard and health. The multivariate analysis performed in the current study suggests that mustard consumption alone should not be considered as an important independent headache trigger, at a population level. However, individual sensitivities to specific foods can range widely from person to person, and mustard may still activate a response in people with increased trigeminal sensitivity. Most of those patients who developed headaches reported symptoms occurring two to four hours after ingesting the mustard.

This timing is in line with previously described latency periods for food-induced headaches. From a mechanistic standpoint, both mustard and related compounds include allyl isothiocyanate that can activate transient receptor potential (TRP) channels, in particular TRPA1, which are involved in nociceptor signalling and headache pathophysiology (Müller-Dott, 2024). These pathways can be activated to cause vascular response, neurogenic inflammation and related release of neuropeptides (including capsaicin gene-related peptide (CGRP)) (SABOOWALA, 2024), known mediators of migraine-like symptoms. The bias towards migraine-type headaches in our cohort argues for a possible biological pathway. However, co-exposure to additional dietary triggers and individual susceptibility are crucial confounders and causation cannot be established from this observational study design. So, future prospective or controlled dietary studies are needed to validate such relationships and elucidate the underlying biological pathways. Dietary triggers commonly elicit symptoms within hours as they are capable of impacting the neurovascular unit via fast metabolic or neurochemical routes. Such as cerebral blood vessel tone which can be affected by vasoactive amines, trigeminal nociceptors which may be triggered food additives and inflammatory mediators that modify neuronal excitability. The temporal pattern observed lends support to the biological plausibility of a diet-related trigger, although it does not establish a causal relationship.

Among individuals reporting headaches after mustard intake, the most common presentation was migraine-like. Over half of these participants described features typical of migraine, including unilateral pain along with symptoms such as nausea and photophobia. This finding is consistent with previous evidence suggesting that dietary factors are more often linked to the triggering of migraine attacks than to other headache subtypes. Migraine, in particular, has a

well-established association with environmental and nutritional triggers, with food-related factors implicated in approximately 20–30% of cases. The relatively low frequency of sinus-type headaches observed in this study may reflect referred facial pain or misclassification, as migraine can present with symptoms resembling sinus pressure or nasal discomfort. Additionally, a considerable proportion of participants reported undefined headache types, underscoring the challenges of accurately classifying headache phenotypes in questionnaire-based studies without clinical evaluation. While the results do not demonstrate a strong independent relationship between mustard intake and headache, several biologically plausible mechanisms may explain its potential role in susceptible individuals. One mechanism involves allyl isothiocyanate, a pungent compound in mustard that can stimulate trigeminal nerve endings within the oral and nasal mucosa (Shusterman, 2023). Activation of these pathways may promote the release of neuropeptides such as calcitonin gene-related peptide (CGRP), a key mediator in migraine pathophysiology. In addition, mustard components may influence vascular tone by inducing transient vasodilation or vasoconstriction (Rahman et al., 2024), processes closely linked to migraine mechanisms. Furthermore, mustard may act synergistically with other dietary factors, where combined food intake influences inflammatory pathways, serotonin metabolism, and neuronal excitability, potentially lowering the threshold for headache initiation. Taken together, these findings suggest that mustard should not be considered a universal dietary trigger. However, clinicians should remain aware of individual variability in food sensitivity. Personalised dietary assessment remains an essential aspect of headache management, and individuals with recurrent migraine may benefit from maintaining food and symptom diaries to identify consistent triggers. In cases where mustard is suspected to contribute to symptoms—particularly with higher intake—a cautious approach is warranted. A trial of temporary elimination followed by a structured reintroduction may help clarify its role and support more tailored clinical management.

Conclusion:-

The findings of this study indicated a descriptive trend of increased headache reporting among individuals with higher mustard consumption. However, this association diminished after adjusting for other dietary factors and demographic variables, suggesting that mustard is unlikely to act as an independent trigger of headache in the general population. However, in many individuals, mustard is likely to be a trigger given the timing of onset and prevalence of migraine type headaches. Additional prospective and mechanistic studies are required to clarify the role of mustard and related dietary factors as pathophysiological triggers in food-related headache. Future studies on serving sizes of mustard to investigate the potential role for its components in headache pathophysiology should therefore use either prospective cohort designs or controlled dietary challenge study designs. Larger sample sizes and clinical diagnosis of headache would add a greater degree of reliability to findings. Biochemical studies to explore the effects of mustard components on trigeminal nerves activation and CGRP release would be helpful for establishing more mechanistic pathways between mustard consumption and headache symptoms.

Conflict of interest:-

Authors declare no conflict of interest amongst each other or any other parties.

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Ethical approval:-

In this study the ethical approval was undertaken by University of Kufa, Faculty of Pharmacy. The design model was done through questionnaire structured study to help in collect all the information required from the participants without include any kind of invasive procedures or interventions and participation was limited to completing several survey questions, written informed consent was neither required nor obtained.

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