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Dietary Inflammatory Potential of Mediterranean Diet Versus A Typical Traditional Pakistani Diet

Juweria Abid[1,2*], Iftikhar Alam[1*], Abdul Momin Rizwan Ahmad[2], Rida Fatima Saeed[3], Umar Farooq[2]

[1,2]Department of Human Nutrition and Dietetics, Bacha Khan University Charsadda, Khyber Pakhtunkhwa, Pakistan.
[2]Department of Nutrition & Dietetics NUMS Institute of Advanced Studies & Research (NIASR), National University of Medical Sciences (NUMS), Rawalpindi. Pakistan.
[3]Department of Biological Sciences, National University of Medical Sciences, Rawalpindi. Pakistan.

***Corresponding author:** Juweria Abid, Iftikhar Alam
*iftikharalam@bkuc.edu.pk
*Juweria.abid@numspak.edu.pk

ABSTRACT
Typical traditional Pakistani diets (TPD) are highly pro-inflammatory and there is an urgent need of making recommendations on diets that are anti-inflammatory. Mediterranean diets (MD) are well-known for their anti-inflammatory characteristics. The main objective of this work was to compare the inflammatory potential of two diets TPD vs MD. In this study, we 1) modelled an MD pattern and 2) assessed whether following a MD improved DII score more than a conventional TPD with additional recommendations with low-fat intake. The results broadly show that modelling an MD pattern is feasible using food items available locally. In addition, the results show the modelled MD pattern had a lower DII score. Furthermore, we found that following a MD for 6 months significantly improved DII score implying that MD led to a more anti-inflammatory diet potential, whereas the TPD did not. The results, as a whole, demonstrated that an MD plan has a high potential of lowering the dietary inflammation as demonstrated by a low (negative) DII score. In addition, the results of the clinical trial demonstrated that adhering to an MD pattern is practically a feasible dietary strategy for as much as 6 months as demonstrated in the current study. More research is needed on other segments of populations with diverse MD modelling options for different diseases.

Keywords: Dietary inflammatory index, Mediterranean diet, typical Pakistani diet, Stress, university students

INTRODUCTION

Chronic low-grade inflammation in the body is recognized to contribute to the development of chronic diseases, including cardiovascular disease. The dietary inflammatory index (DII) provides a method to assess the likely impact that one's diet is having on inflammation (Hariharan et al., 2022).

The DII is calculated based on intake of 45 diet parameters (nutrients or individual foods) known to influence levels of circulating inflammatory markers, in either an anti- or pro-inflammatory manner. The score can range from -9 to +8. The more negative a person's score the more anti-inflammatory their diet potential is, and the more positive a person's score the more pro-inflammatory their diet potential is. The DII provides a useful alternative to measuring levels of inflammatory markers which require invasive testing, are costly and not routinely available (Alam et al., 2018).

The typical Pakistan diet (TPD) is high in saturated fat (But et al., 2009). Usually, the health-care professionals recommend adhering to diets like TPD but with the modification of low-fat for the prevention of cardiovascular disease (August, 2024). Based on a number of reports (Masini et al., 2024; Godny et al., 2024). However, we hypothesized that a MD is likely to have a higher anti-inflammatory potential due to its composition. To test if this was true, we assessed: (1) the DII scores of a Mediterranean diet model and a low-fat diet model, and (2) if DII score improved following intervention with these two alternate diet models in normal university students.

Recent studies have highlighted the growing global interest in dietary patterns that can modulate inflammation, as chronic inflammation is now recognized as a central mechanism in the pathogenesis of many non-communicable diseases. The Mediterranean diet has consistently been shown to possess strong anti-inflammatory properties, largely due to its rich content of bioactive compounds such as polyphenols, antioxidants, and omega-3 fatty acids. These components have been linked to reduced levels of proinflammatory cytokines and other biomarkers of inflammation. On the other hand, diets high in saturated fats and refined sugars, such as the typical Pakistani diet, have been associated with increased levels of inflammatory markers, contributing to a higher risk of metabolic syndrome, obesity, and cardiovascular diseases (Zhao et al., 2023). Understanding the inflammatory potential of different dietary models is crucial, particularly in populations transitioning from traditional diets to more Westernized eating patterns, as seen in Pakistan. This study aims to provide insight into how dietary modifications can influence inflammation, offering potential strategies for reducing chronic disease risk through diet.

METHODS AND MATERIALS

We wanted to design a MD model that must be highly anti-inflammatory. The details of the designing of MD model can be found in our previous research paper (Alam et al., 2023). Briefly, three necessary steps were followed in designing the MD model: 1) as a first step, we defined the target nutrients that we wanted to get from our MD model; 2) these nutrients were then translated into healthy foods using the food exchange system; and finally, 3) different recipes for the whole day and even weeks were constructed on the basis of step 2.

Recipes were created and adjusted to meet menu objectives at the 2000 calorie level and corresponding additions of menus at the 2000 kcal level were utilized to lay out 2500, 3000, and 3500 kcal/day to take into consideration differing energy necessities of members. Meal plans were analyzed for their macro- and micro-nutrients composition using our lab-built nutrition composition database as extensively reported in our previous works.

The two dietary plans were compared for differences in menu goals including macronutrients (% Calories), Omega 6: Omega 3, % Kcal saturated fat, Grains (servings/day), Fruit & Vegetables (servings/day), Nuts (servings/day), Fish (servings per week), Legumes (servings/day), Poultry (servings/day), Red & processed meats (servings/day), Sweets, pastries (servings/day), Sugar sweetened beverages (servings/day). The TPD menus were created from the previous research studies (Yasmen et al., 2019). The only modification was incorporated to make these recipes with low fat. Thus, the resultant recipes were representative of traditional Pakistani diets with low fat content as usually recommended by the doctors to patients with risks of CVD.

The two diet plans were compared for their potential of (anti)inflammatory effects. For this purpose, two groups of university students were recruited. One group (Test) followed the MD plan. The other group (Control) followed TPD plan. The duration of the intervention was 6 months. Assessment was done at baseline, after 3 month and at the end of the intervention (6 months).

DII calculation

The details of DII calculations are provided elsewhere (Alam et al., 2018). Briefly, Shivappa et al. evaluated 43 articles (published between 1950 and 2010) to investigate the correlation between inflammation and 45 food and nutrient parameters. This led to the development and validation of DII, a score that ranged from 7.98 (indicating strongly pro-inflammatory) to -8.87 (indicating strongly anti-inflammatory). The DII scores were computed at baseline and six months after the intervention in the current study. The estimated dietary intake data were compared to a reference global daily mean and standard deviation intake (from 11 countries) for each parameter to determine a Z-score. The percentile value of each Z-score was then multiplied by 2 and subtracted from 1. The parameter-specific DII score was calculated by multiplying the quantity for each intake parameter by its corresponding parameter-specific inflammatory effect score. Finally, the sum of each of these 45 scores was calculated to determine the aggregate DII score.

RESULTS

Table 1 shows a three-day menu cycle of the two dietary plans. In the two dietary plans, some food items were common. All food items included in the the meal plans were locally available.

Table 1: A 3-day Menu Cycle

		Day1	Day2	Day3
Mediterranean Dietary Plan	**B**	-Maize bread with olive oil -Green/Black Tea	-Whole wheat bread with olive oil -Green/Black Tea	Wheat and Maize mixed bread with olive oil - Milk -egg omelet
	L	-Bread from whole wheat grain -vegetables curry -green leafy salad -pickle of olive fruit -lassi -apple	-Vegetable Rice -Beans Curry -meat (mutton) -lassi -pear	-Cheese -legumes -poultry -lassi -onion/tomato/podina mixed salad
	D	-Rice -Fish grilled -tomato chitini -pear	-mixed vegetables curry -Whole grain wheat bread -yogurt -light Pudding with nuts -apple	-vegetables Biryani -Daal Haleem -yogurt -tomato Chitni -carrot
	S	-badam -apple -green tea	-pistachio -pear -green tea	-roasted black gram -green tean with lemon -banana
	B	- Halwa poori -Black tea with milk	-Paratha (fried with ghee) -Egg fried in ghee -Black tea with milk -Roghni Naan	-ghee Fried bread -Choly spicy saalan -Black tea with milk

Typical Pakistani Dietary Plan	L	- Ground Beef Kebabs -Kabali Pulao -Achar -Wheat Bread -halwa meeta	- Chicken Karahi. - Chapli Kabab -Wheat Bread -Custrad	-Chicken handi -Wheat Bread -achar -custard
	D	- Chicken Malai Tikka & Chicken Malai Boti. -wheat bread -Zarda	- Seekh kabab -Spicy Biryani -wheat bread	- Beef Korma -wheat bread -Kabali pulao
	S	-paratha laden with ghee -black tea	-black tea -samosa	-black tea -pakora

DII Score of the two diet plans

DII score of the two diet plans is shown in Figure 1. The mean (SD) DII score of MD model was -5.53 (2.33) and that of TPD plan was -0.33 (1.22). The DII score of MD was significantly lower than that of TPD (P<0.05).

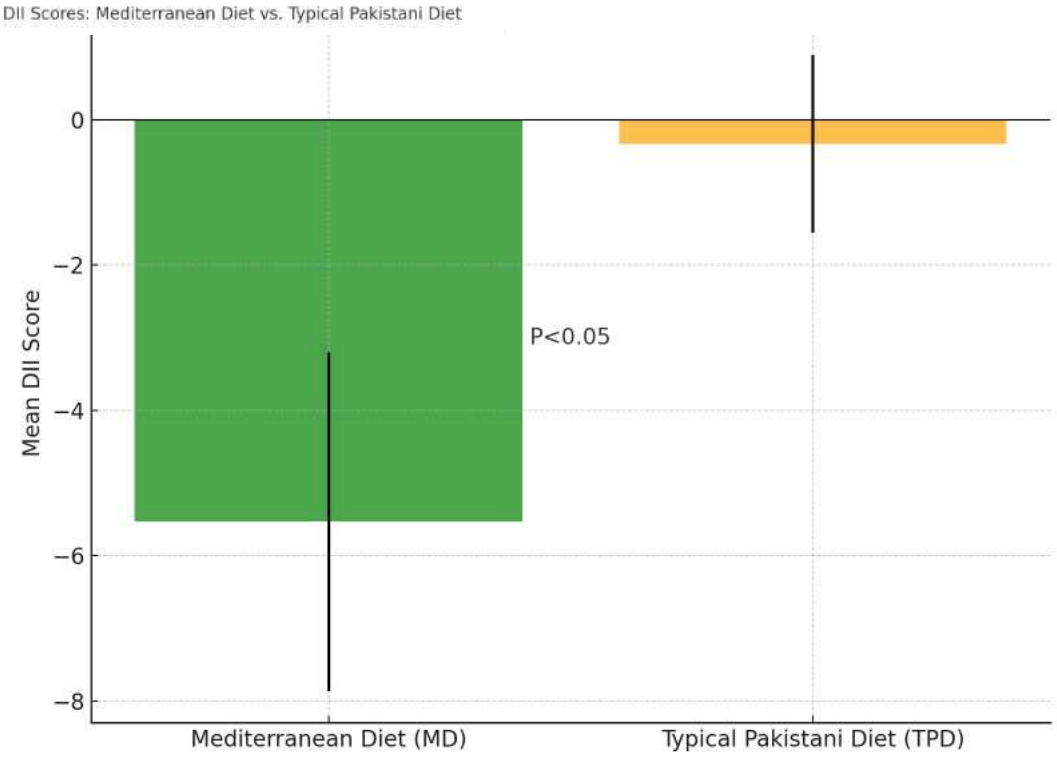

Fig 1: DII score for the two diet plans

DII score of the diet test and control groups

Change in the concentration of DII are shown in Figure 2. Table 2 shows mean DII values of the Test and Control groups at various timepoints of the study. Table 3 shows differences in the DII values of the Test and Control groups at various timepoints of the study. There was a drop in the DII concentration in the test group. However, the concentration of DII remained unchanged in control group. There was no significant difference in the DII score at baseline between the Test and Control groups (p = 0.131). Following 2-6 months of dietary intervention, the Test group had significantly changed to a more anti-inflammatory diet with a reduction in mean (std) DII score from 5.99 (1.56) at baseline to −4.01 (2.543) at 3 months and further to -5.35 (2.211) at 6 months (Table 1) with a difference of 10.007 and 11.345 at baseline vs 3 month and baseline vs 6 months, respectively. The Control group was unchanged after 3 months and 6 months
(p>0.05).

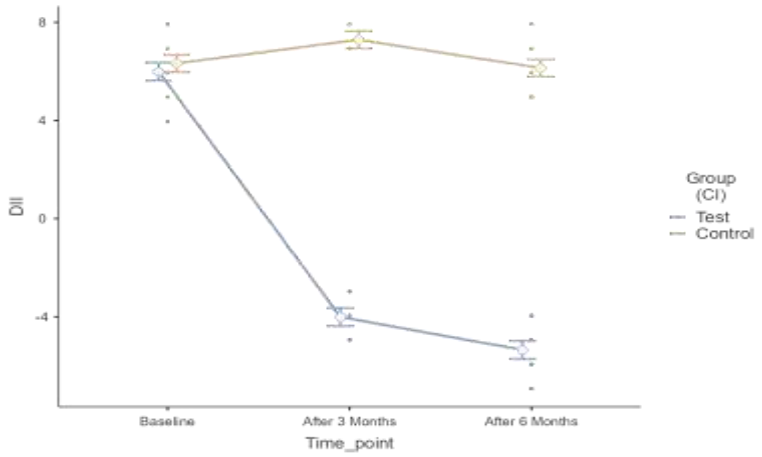

Figure 21: Changes in DII score at different time points of the study in control and test groups

Table 21: Mean DII values of the Test and Control groups at various timepoints of the study

Estimate Marginal Means - Time_point ✻ Group					
				95% Confidence Intervals	
Time_point	**Group**	**Mean**	**SE**	**Lower**	**Upper**
Baseline	Test	5.99	0.187	5.63	6.36
Baseline	Control	6.33	0.177	5.98	6.68
After 3 Months	Test	-4.01	0.187	-4.38	-3.65
After 3 Months	Control	7.29	0.177	6.94	7.64
After 6 Months	Test	-5.35	0.187	-5.72	-4.98
After 6 Months	Control	6.13	0.177	5.78	6.48

Table 3: Differences in the DII values of the Test and Control groups at various timepoints of the study

Post Hoc comparison: Time_point ✻ Group										
Comparison							**95% Confidence Intervals**			
Time_point	**Group**	**Time_point**		**Group**	**Difference**	**SE**	**Lower**	**Upper**	**t**	**pbonferroni**
Baseline	Test	Baseline		Control	-0.333	0.258	-0.84	0.175	-1.292	0.991
Baseline	Test	After Months	3	Test	10.007	0.264	9.485	10.529	37.884	< .001
Baseline	Test	After Months	6	Test	11.345	0.264	10.823	11.867	42.948	< .001
Baseline	Control	After Months	3	Control	-0.966	0.251	-1.462	-0.47	-3.849	0.002
Baseline	Control	After Months	6	Control	0.192	0.251	-0.304	0.688	0.765	0.991

DISCUSSION

Firstly, we found that our MD model had a markedly lower (more anti-inflammatory) DII score than the low-fat TPD model. The Mediterranean diet score was -5.53, whereas the low-fat TPD DII score was -0.33. Secondly, we found that the study group who followed the Mediterranean diet intervention significantly improved their mean DII score; it became more negative from -0.4 at the start to -1.7 after 6months. By comparison, the study group on the TPD (low-fat diet) group did not significantly improve their DII score (in fact it tended to become slightly more positive) after 6-months (Fig 2).

The important question is that why MD has greater anti-inflammatory potential? The 45 diet parameters which are used to calculate DII score include a range of macronutrients, vitamins, minerals, and flavonoids (types of bioactive substances found in plant foods), as well as herbs and spices (Alam et al., 2018). The composition of the MD lends itself to a higher composition of many of the healthy diet parameters that are included in the DII, whereas a TPD, though was a low-fat diet, does not necessarily include these foods or cuisine elements. For example, both a low-fat diet and Mediterranean diet promote vegetables, fruits and wholegrains; however, the Mediterranean diet specifically promotes extra virgin olive oil, nuts, legumes, oily fish, onion, garlic, leafy greens, herbs and red wine. These specific foods which are mostly plant-based and highly nutritious contribute to the diet's anti-inflammatory potential.

Other studies have demonstrated that people who have a lower (more anti-inflammatory) DII score have reduced levels of inflammatory markers, as well as a reduced risk of a range of stress in students (Arsalan et al., 2022; Attlee et al., 2022; Alfreeh et al., 2020), and chronic diseases including cardiovascular disease (Ruiz-Canela et al., 2016; Hariharan et al., 2022). This suggests that the improvement in DII score that was achieved in the university students using our Mediterranean diet

intervention is likely to lead to reduced inflammation and stress – but, more research is needed to test whether this is true. The TPD is high in saturated fats (Afnan et al., 2022; Yakub et al., 2010). Ghee, a form of saturated fats, is still considered a sign of prosperity and an essential ingredient of a diet of social value (Chavadi et al., 2018; Kandhro et al., 2013; Tarar et al., 2020; Sami et al., 2023). Pakistanis eat less lentils and vegetables compared to others South Asians. In addition, they have a high consumption of sweets with high content of sugar and ghee (clarified butter), and less whole-meal bread, less artificial sweeteners, and no brown rice resulting in high fat and low fiber diet. Such a diet could lead to many diseases and can add to stress and obesity. Homemade ghee is slowly being replaced by commercially sold ghee (Vanaspati Ghee) as it is more easily accessible.

For the present study, we suggested to the participants in the control group to adhere to their TPD but the only modification recommended was to reduce the fat intake by as much as <50% of the usual practice. A low-fat diet is currently recommended in practice for prevention of stress (Wells et al., 1998; Bradbury et al., 2004; Soltani et al., 2024). However, our findings demonstrated that implementation of a Mediterranean diet, which is higher in healthy fats, plant-based foods, and herbs and spices, would be likely to achieve a greater improvement in diet quality. As reported (Bremner et al., 2020), although a Mediterranean diet, in combination with other behavioral changes, was found to have beneficial effects on perceived stress and well-being, it has not been shown to specifically benefit depression. Some elements of the Mediterranean diet, such as omega-3 fatty acids (found in fish), have been found to be beneficial in some clinical trials. Meanwhile, the addition of folate to the diet (with reduction in homocysteine) is associated with decreased symptoms of depression. In countries such as the United States, folate is added to flour, so depression-related folate deficiency is no longer an issue clinically, although not all countries incorporate the addition of folate to food. Thus, clinicians are likely to continue to advocate for adherence to the Mediterranean diet or diets low in fat and high in n-3 PUFAs as part of a general program of healthpromoting behaviors, including exercise. It cannot be assumed, however, that supplements like EPA and DHA will confer the same advantages as consumption of fish, whose dietary compilation they are designed to emulate. On the other end, the relationship between high saturated fat diets and mental disorders is more complex.

It appears that intake of fat may have an acute effect on mood, leading to symptoms of anxiety and depression. In addition, resolution of depression was associated with a reduction in fat intake in some studies, although it is not clear if the reduction in fat led to resolution of depression, or whether resolution of depression led to improved eating habits. Finally, a healthy diet with reduction in obesity will likely have beneficial effects on mental health through improved feelings of wellness and self-esteem, in addition to the known association between obesity and depression. Observational studies of the effects of diet for weight loss and dietary interventions on depression and anxiety have had mixed results, and it is not clear if the science supports clear recommendations for dietary interventions, apart from the "does no harm" approach. Studies with the greatest effect were those where diet was paired with exercise training, which is significant since studies showed benefits of aerobic exercise equivalent to antidepressants for the treatment of clinical depression. The strongest evidence for a role of diet intervention for depression was in the area of PUFA supplements, specifically higher doses of EPA, for patients with the clinical diagnosis of depression. Since there are essentially no side effects, its use as an adjunct to antidepressants should certainly be considered as part of a treatment armamentarium, although not a substitute for current.

An improvement in DII score can therefore be achieved through healthy diet intervention, which in turn could reduce inflammation and other cardiometabolic risk markers, as well as prevent CHD. To our knowledge, as reported by (Mayr et al., 2018), only two studies have assessed the impact of diet intervention on the DII. One of these trials showed short (2-month), but not longer-term (6-month), improvement in DII with vegetarian compared to omnivorous diets in a small cohort (n = 63) of overweight adults. The other study of a large cohort (n = 14, 339) of post-menopausal women reported modest improvement in DII after 6-years on a low-fat diet. Neither of these studies, however, assessed whether the reduction in DII score achieved with improved diet led to a change in inflammatory markers.

Current recommendations in Pakistan promote a low-fat diet for the prevention of stress (Mahmood et al., 2015), for which there is some evidence to suggest this type of diet is associated with reduced DII scores (Bremner et al., 2020). A MD, by nature of its composition, is likely to lead to a more anti-inflammatory DII score. The impact of adherence to a MD on DII scores is of interest both because of the popularity of Mediterranean cuisine and concern about chronic, low-grade, systemic inflammation.

Therefore, our objectives were to determine (1) how the DII score of a MD compared with that of a low-fat diet, (2) the impact of randomization to an intervention with these two diets for 6 months on change in DII score and CRP and IL-6 (two inflammatory biomarkers on which the DII development was based), and (3) the association between improvement in MD adherence score and DII score, in an adult population with CHD. We hypothesized that the prescribed MD model would have a lower DII score (i.e., greater dietary anti-inflammatory potential) than that of the low-fat diet and that this would translate to greater improvement in DII score and inflammation in participants randomized to the MD intervention. We also hypothesized an association between improvement in MD adherence and DII scores.

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Conflict of interest

All authors declare 'no conflict of interest'. The present work is part of PhD dissertation of Ms. Juweria Abid (the first author) at Bacha Khan University Charsadda, KP, Pakistan

References

1. Afnan, B. H., Shaikh, S. S., Rahim, A., Ahmed, W., Soomro, S., Khan, A., ... & Ellahi, B. (2022). Too many calories, Refined carbohydrates, and saturated fat Consumption endow to Nonalcoholic Fatty Liver Disease in Pakistani Adults.
2. Alam, I., Abid, J., Ahmad, A. M. R., & Ejaz, F. (2023). Designing a Mediterranean-like Diet Plan to be Used for a Randomized Controlled Clinical Trial. *Journal of Food and Dietetics Research*, *3*(3). Alam, I., Shivappa, N., Hebert, J. R., Pawelec, G., & Larbi, A. (2018). Relationships between the inflammatory potential of the diet, aging and anthropometric measurements in a cross-sectional study in Pakistan. *Nutrition and healthy aging*, *4*(4), 335-343.
3. Alfreeh, L., Abulmeaty, M. M., Abudawood, M., Aljaser, F., Shivappa, N., Hebert, J. R., ... & Aljuraiban, G. S. (2020). Association between the inflammatory potential of diet and stress among female college students. *Nutrients*, *12*(8), 2389.
4. Arslan, E., Ozlu, T., Kenger, E. B., & Meral Koc, B. (2022). Determination of the relationship between dietary inflammatory index and depression status in female students. *Nutrition and Health*, 02601060221136357.
5. Attlee, A., Saravanan, C., Shivappa, N., Wirth, M. D., Aljaberi, M., Alkaabi, R., ... & Hebert, J. R. (2022). Higher dietary inflammatory index scores are associated with stress and anxiety in dormitory-residing female university students in the United Arab Emirates. *Frontiers in Nutrition*, *9*, 814409.
6. August, N. H. D. (2024). Is a High-Fat Diet Healthy? What the Science Says. *Total Health*, *8*, 14. Bradbury, J., Myers, S., & Oliver, C. (2004). Are low-fat diets associated with stress. *Int J Nat Med*, *1*, 3342.
7. Bremner, J. D., Moazzami, K., Wittbrodt, M. T., Nye, J. A., Lima, B. B., Gillespie, C. F., ... & Vaccarino, V. (2020). Diet, stress and mental health. *Nutrients*, *12*(8), 2428.
8. Butt, M. S., & Sultan, M. T. (2009). Levels of trans fats in diets consumed in developing economies. *Journal of AOAC International*, *92*(5), 1277-1283.
9. Chavadi, C. A., Vishwanatha, M. R., & Mubeen, S. (2018). Ghee with Glee: A Study of How Consumers Evaluate Product Packaging. *Metamorphosis*, *17*(2), 100-110.
10. Godny, L., & Dotan, I. (2024). Is the Mediterranean Diet in Inflammatory Bowel Diseases Ready for Prime Time?. *Journal of the Canadian Association of Gastroenterology*, *7*(1), 97-103.
11. Hariharan, R., Odjidja, E. N., Scott, D., Shivappa, N., Hébert, J. R., Hodge, A., & de Courten, B. (2022). The dietary inflammatory index, obesity, type 2 diabetes, and cardiovascular risk factors and diseases. *Obesity Reviews*, *23*(1), e13349.
12. Kandhro, A. A., Sultana, R., Saleem, R., Lal, A., & Yasmin, A. (2013). Characteristics assessment of cooking oil and vanaspati ghee. *Pakistan Journal of Scientific & Industrial Research Series A: Physical Sciences*, *56*(1), 6-13.
13. Mahmood, H., Abid, A. R., Riaz, R., & Mallick, N. H. (2015). Relation of cholesterol level to dietary fat intake in patients of ischemic heart disease. *Cardiol Pharmacol*, *4*, 141.
14. Masini, A., Dallolio, L., Sanmarchi, F., Lovecchio, F., Falato, M., Longobucco, Y., ... & Sacchetti, R. (2024, February). Adherence to the Mediterranean Diet in Children and Adolescents and Association with Multiple Outcomes: An Umbrella Review. In *Healthcare* (Vol. 12, No. 4, p. 449). MDPI.
15. Mayr, H. L., Thomas, C. J., Tierney, A. C., Kucianski, T., George, E. S., Ruiz-Canela, M., ... & Itsiopoulos, C. (2018). Randomization to 6-month Mediterranean diet compared with a low-fat diet leads to improvement in Dietary Inflammatory Index scores in patients with coronary heart disease: the AUSMED Heart Trial. *Nutrition research*, *55*, 94-107.
16. Ruiz-Canela, M., Bes-Rastrollo, M., & Martínez-González, M. A. (2016). The role of dietary inflammatory index in cardiovascular disease, metabolic syndrome and mortality. *International journal of molecular sciences*, *17*(8), 1265.
17. Sami, U., Choudary, I. A., Umar, I. A., Shoaib, N., & Amjad, M. (2023). Health or taste: understanding consumers' preferences towards cooking mediums in Pakistan.
18. Soltani, S., Sangsefidi, Z. S., Asoudeh, F., Torabynasab, K., Zeraattalab-Motlagh, S., Hejazi, M., ... & Abdollahi, S. (2024). Effect of Low-Fat Diet on Depression Score in Adults: A Systematic Review and Meta-Analysis of Randomized Controlled Clinical Trials. *Nutrition Reviews*, nuae069.
19. Tarar, O. M., Ahmed, K. M., Nishtar, N. A., Achakzai, A. B., Gulzar, Y., Delles, C., & Al-Jawaldeh, A. (2020). Understanding the complexities of prevalence of trans fat and its control in food supply in Pakistan. *The Journal of Clinical Hypertension*, *22*(8), 1338-1346.
20. Wells, Anita S., Nicholas W. Read, Jonathan DE Laugharne, and N. S. Ahluwalia. "Alterations in mood after changing to a low-fat diet." *British Journal of Nutrition* 79, no. 1 (1998): 23-30.
21. Wells, Anita S., Nicholas W. Read, Jonathan DE Laugharne, and N. S. Ahluwalia. "Alterations in mood after changing to a low-fat diet." *British Journal of Nutrition* 79, no. 1 (1998): 23-30.
22. Yakub, M., Iqbal, M. P., & Iqbal, R. (2010). Dietary patterns are associated with hyperhomocysteinemia in an urban Pakistani population. *The Journal of nutrition*, *140*(7), 1261-1266.
23. Yasmeen, I. K. F., Ahmad, J., Abdullah, A., ud Din, Z., Iqbal, Z., & Iqbal, M. (2019). Developing a mealplanning exchange list for commonly consumed Pakistani dishes. *Progress in Nutrition*, *21*, 421-429.
24. Zhao, Q., Tan, X., Su, Z., Manzi, H. P., Su, L., Tang, Z., & Zhang, Y. (2023). The relationship between the dietary inflammatory index (DII) and metabolic syndrome (MetS) in middle-aged and elderly individuals in the United States. *Nutrients*, *15*(8), 1857.