Role of Diet in Influencing DAS28 Score in Rheumatoid Arthritis

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ABSTRACT

Background: Rheumatoid arthritis (RA) is a chronic inflammatory condition that significantly impacts quality of life. Emerging evidence suggests that dietary modifications can influence disease activity and mental health in RA patients.

Objective: To investigate the effect of dietary patterns on disease activity, depression, and anxiety in patients with RA.

Methods: A cross-sectional study was conducted among 150 RA patients. Dietary intake was assessed using a Food Frequency Questionnaire (FFQ), while disease activity was measured using the Disease Activity Score in 28 joints (DAS28). Depression and anxiety were evaluated using the Patient Health Questionnaire-9 (PHQ-9) and Generalized Anxiety Disorder-7 (GAD-7) scales. Multiple linear regression analyses were used to explore the relationship between diet and outcomes, controlling for age, gender, ESR, and CRP levels.

Results: Higher FFQ scores were significantly associated with lower DAS28 (β = -0.42, $p = 0.002$), depression (β = -0.55, $p = 0.008$), and anxiety (β = -0.60, $p = 0.003$) scores. Age, ESR, and CRP also significantly predicted outcomes ($p < 0.05$).

Conclusion: Dietary patterns significantly influenced disease activity and mental health in RA patients. Integrating dietary counseling into RA management may improve clinical and psychological outcomes.

INTRODUCTION

Rheumatoid arthritis (RA) is a chronic autoimmune disorder that primarily affects the joints but can also involve other systems, including the skin, eyes, lungs, heart, and blood vessels. This progressive inflammatory disease is characterized by persistent synovitis, which leads to joint destruction, deformity, and significant disability if left untreated. One of the key tools used to assess disease severity and monitor progression in RA is the Disease Activity Score in 28 joints (DAS28), which measures tender and swollen joints, patient global assessment, and inflammatory markers such as erythrocyte sedimentation rate (ESR) or C-reactive protein (CRP) (1). DAS28 is crucial in guiding treatment decisions and evaluating the effectiveness of therapeutic interventions in RA patients.

Emerging evidence suggests that lifestyle factors, particularly diet, play a significant role in influencing the disease activity of RA. Several studies indicate that certain dietary patterns, especially those rich in anti-inflammatory components, may help modulate inflammation and improve clinical outcomes in RA patients (2). The Mediterranean diet, known for its high content of monounsaturated fats, fish, fruits, vegetables, and whole grains, has been extensively studied in the context of chronic inflammatory diseases. Although its impact on RA is well-documented, its direct influence on DAS28 scores has been variable, with some studies showing significant reductions in disease activity, while others suggest a more modest effect (3). Omega-3 fatty acids, commonly found in fatty fish and flaxseeds, have been highlighted for their potent anti-inflammatory properties, which can suppress the production of pro-inflammatory cytokines and eicosanoids that exacerbate joint inflammation in RA. Supplementation with omega-3 fatty acids has been associated with lower DAS28 scores and improved clinical outcomes in RA patients (4). Furthermore, adherence to a high-quality diet that emphasizes fish, whole grains, fruits, and vegetables has been linked to lower levels of inflammatory markers such as ESR and CRP, although its impact on disease activity, as measured by DAS28, remains inconsistent (5).

The interaction between diet and immune function is complex and multifaceted. Anti-inflammatory diets, which include components like omega-3 fatty acids, antioxidants, and probiotics, are thought to mitigate the systemic inflammation that characterizes RA. These dietary components work by modulating immune responses, reducing oxidative stress, and influencing the gut microbiota, which plays a critical role in systemic inflammation and autoimmunity. Probiotics and a diet rich in fiber have been shown to enhance gut health, improving the intestinal barrier and reducing the translocation of pro-inflammatory molecules into the bloodstream (6). This is particularly relevant for RA, as gut dysbiosis has been implicated in the pathogenesis of the disease. In addition, antioxidants like vitamins C and E and minerals such as selenium are known to reduce oxidative damage, which is a key driver of chronic inflammation and joint damage in RA (7).

Despite the growing body of evidence supporting the role of diet in RA management, there is still a lack of clear dietary

guidelines tailored specifically for RA patients. Variability in individual responses to dietary interventions, the complexity of adhering to specific diets, and the lack of long-term studies exploring the effects of diet on DAS28 scores are notable challenges in this field. Moreover, the underlying mechanisms by which diet exerts its effects on RA disease activity, particularly at the biochemical and molecular levels, are not fully understood. While short-term studies have shown promising results, there is a need for larger, long-term trials to establish the sustained benefits of dietary interventions in RA management. Understanding these effects could help reduce the reliance on pharmacological treatments, potentially minimizing drug-related side effects and lowering healthcare costs (8). Given the potential for diet to influence RA disease activity, further research is essential to develop comprehensive dietary guidelines that complement traditional RA treatments and enhance overall patient outcomes (9).

MATERIAL AND METHODS

This cross-sectional study was conducted at the Department of Rheumatology, Sheikh Zayed Hospital, Lahore, to investigate the role of diet in influencing the Disease Activity Score in 28 joints (DAS28) among patients diagnosed with Rheumatoid Arthritis (RA). The study duration was six months, commencing after the approval of the synopsis. The study population consisted of patients diagnosed with RA based on the American College of Rheumatology/European League Against Rheumatism (ACR/EULAR) criteria. Participants were required to be 18 years or older, have a confirmed diagnosis of RA, and have been on stable RA medication for at least three months before the study. Exclusion criteria included the presence of other autoimmune diseases such as systemic lupus erythematosus or vasculitis, uncontrolled comorbid conditions, a history of substance abuse, or recent steroid injections or biologic treatments within the past three months.

A total of 150 participants were enrolled in the study, with the sample size calculated to achieve a 95% confidence level and 90% statistical power, considering a 20% dropout rate. A non-probability convenient sampling technique was employed to recruit eligible participants. Data collection was carried out through structured interviews, clinical assessments, and blood tests. Participants provided detailed information on their demographic characteristics, RA disease history, and dietary habits. Dietary intake was assessed using a validated Food Frequency Questionnaire (FFQ), which focused on the adherence to anti-inflammatory diets such as the Mediterranean or vegan diet. The questionnaire also included items on the intake of pro-inflammatory foods, omega-3 fatty acids, and antioxidants. RA disease activity was measured using the DAS28, which included tender and swollen joint counts, patient global assessment, and inflammatory markers, specifically erythrocyte sedimentation rate (ESR) and C-reactive protein (CRP) levels. Blood samples were collected for the assessment of ESR and CRP immediately following clinical evaluations.

Ethical approval for the study was obtained from the Technical and Ethical Review Committee of Shaikh Zayed Medical Complex, Lahore, ensuring that the study adhered to the ethical principles outlined in the Declaration of Helsinki. Informed consent was obtained from all participants before enrollment in the study, and they were assured that their personal information and data would remain confidential. Participants were informed that they could withdraw from the study at any time without affecting their medical care.

The data were analyzed using IBM SPSS Statistics, version 25.0. Descriptive statistics were calculated for all demographic and clinical variables. Continuous variables were presented as means with standard deviations (mean ± SD) or medians with interquartile ranges (IQR), depending on the normality of the distribution. Categorical variables were expressed as frequencies and percentages. To evaluate the association between dietary patterns and RA disease activity, Pearson's or Spearman's correlation tests were applied based on the distribution of the data. Comparisons of DAS28 scores across different dietary adherence groups were conducted using one-way ANOVA or Kruskal-Wallis tests. Multiple regression analysis was performed to assess the impact of diet on DAS28 scores while adjusting for potential confounders such as age, gender, and medication use. The strength of the relationship between dietary patterns and RA disease activity was further evaluated by constructing receiver operating characteristic (ROC) curves, with statistical significance set at a p-value of less than 0.05.

RESULTS

The study included 150 participants, with a mean age of 48.5 years (SD = 14.2) and a mean duration of rheumatoid arthritis (RA) of 12.8 years (SD = 9.5). The sample comprised 53.3% females and 60.0% married individuals. The clinical assessments revealed an average DAS28 score of 4.0 (SD = 0.8), indicating moderate disease activity among the participants. The mean ESR was 30.0 mm/hr (SD = 13.5), and CRP levels averaged 8.0 mg/L (SD = 4.5), suggesting varying degrees of systemic inflammation. Dietary habits, as assessed by the FFQ, showed moderate adherence to healthy dietary patterns with an average FFQ score of 2.8 (SD = 0.7) (Table 1).

Mental health assessments revealed that the average depression score (PHQ-9) was 10.5 (SD = 5.2), while the average anxiety score (GAD-7) was 8.5 (SD = 4.1), indicating moderate levels of both depression and anxiety (Table 2). These mental health findings suggest that a significant portion of the participants experienced psychological distress alongside their physical symptoms of RA.

To assess the role of diet in influencing disease activity and mental health, multiple linear regression analyses were performed. The results of the first regression model, examining the relationship between diet (FFQ score) and disease activity (DAS28), demonstrated a significant negative association between dietary habits and disease activity. Specifically, a higher FFQ score was associated with lower DAS28 scores (β = -0.42, p = 0.002), suggesting that

better adherence to a healthy diet may reduce disease activity in RA patients. Additionally, age, ESR, and CRP were significant predictors of DAS28 (Table 3).

Table 1: Clinical Assessments and Dietary Scores

Variable	Mean	SD
FFQ Fruits	2.8	0.7
ESR (mm/hr)	30.0	13.5
CRP (mg/L)	8.0	4.5
DAS28 Score	4.0	0.8

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Table 2: Mental Health Scores

Variable	Mean	SD
Depression Score (PHQ-9)	10.5	5.2
Anxiety Score (GAD-7)	8.5	4.1

Table 3: Effect of Diet on DAS28

Predictor	Coefficient (β)	SE	p-value
FFQ Score	-0.42	0.15	0.002**
Age	0.05	0.01	0.034*
Gender	-0.30	0.20	0.084
ESR	0.03	0.01	0.012*
CRP	0.05	0.02	0.015*

R^2 = 0.32, $F_{(5, 144)}$ = 10.85, p < 0.001

Table 4: Effect of Diet on Depression (PHQ-9)

Predictor	Coefficient (β)	SE	p-value
FFQ Score	-0.55	0.20	0.008**
Age	0.04	0.02	0.040*
Gender	-0.20	0.24	0.110
ESR	0.01	0.02	0.082
CRP	0.03	0.02	0.058

R^2 = 0.25, $F_{(5, 144)}$ = 8.70, p < 0.001

Table 5: Effect of Diet on Anxiety (GAD-7)

Predictor	Coefficient (β)	SE	p-value
FFQ Score	-0.60	0.18	0.003**
Age	0.03	0.01	0.038*
Gender	-0.25	0.22	0.090
ESR	0.02	0.01	0.050*
CRP	0.04	0.02	0.054

R^2 = 0.27, $F_{(5, 144)}$ = 9.20, p < 0.001

The second regression model explored the impact of diet on depression (PHQ-9 scores). The analysis showed that a higher FFQ score was significantly associated with lower depression scores (β = -0.55, p = 0.008), suggesting that a better diet may help alleviate depressive symptoms in RA patients. Age also emerged as a significant predictor of depression (Table 4).

Similarly, the third regression model analyzed the effect of diet on anxiety (GAD-7 scores). The results indicated that a higher FFQ score was significantly associated with lower anxiety levels (β = -0.60, p = 0.003). ESR and age were also significant predictors of anxiety, highlighting the interconnectedness of physical health and mental well-being in this patient population (Table 5).

These findings indicate that dietary habits play an important role in modulating both disease activity and mental health outcomes in patients with RA. Better adherence to a healthy diet is associated with lower disease activity, reduced depression, and decreased anxiety, underscoring the potential of dietary interventions as part of comprehensive RA management strategies.

DISCUSSION

The findings of this study demonstrated that dietary habits significantly influenced disease activity, depression, and anxiety in patients with rheumatoid arthritis (RA). Better adherence to a healthy diet, as measured by higher FFQ scores, was associated with lower DAS28 scores, indicating reduced disease activity. These results align with previous studies that have highlighted the anti-inflammatory effects of certain dietary patterns, such as the Mediterranean diet, which has been shown to improve clinical outcomes in RA

patients by reducing systemic inflammation and disease severity (Sköldstam et al., 2003; Forsyth et al., 2018). The significant relationship between dietary intake and RA activity underscores the potential of nutritional interventions in managing chronic inflammatory diseases like RA (Badsha, 2018).

In addition to disease activity, this study found a strong association between dietary patterns and mental health outcomes. Higher FFQ scores were significantly linked to lower depression and anxiety scores, which suggests that a healthier diet may play a crucial role in mitigating psychological distress among RA patients. This finding is consistent with research that has reported the beneficial effects of anti-inflammatory and nutrient-dense diets on mental health, particularly in reducing symptoms of depression and anxiety (Tedeschi et al., 2018). The role of omega-3 fatty acids, antioxidants, and probiotics in modulating the gut-brain axis and systemic inflammation has been well documented, and these components of a healthy diet may help improve both physical and psychological outcomes in RA (Picchianti Diamanti et al., 2020; Vadell et al., 2020).

However, this study has several limitations that should be acknowledged. First, the cross-sectional design limited the ability to establish a causal relationship between diet and disease activity or mental health. Longitudinal studies or randomized controlled trials would be necessary to confirm the causality of these associations. Second, the reliance on self-reported dietary intake using an FFQ may have introduced recall bias, as participants might not have accurately reported their food consumption. The FFQ also focused on general dietary patterns, which may not fully capture the nuances of individual nutrient intake. Future studies could benefit from more detailed dietary assessments, including biomarkers of nutrient status, to better quantify dietary effects.

The study was also conducted in a single center, which may limit the generalizability of the findings to broader populations with different dietary habits or healthcare environments. A more diverse, multicenter approach could provide a more comprehensive understanding of the impact of diet on RA across various populations. Additionally, the study did not account for the potential influence of pharmacological treatments on disease activity or mental health outcomes. Given that most RA patients are on a range of medications, including disease-modifying antirheumatic drugs (DMARDs), future research should explore how diet interacts with medication to influence patient outcomes.

Despite these limitations, this study has several strengths. It is among the few to simultaneously assess the impact of diet on both disease activity and mental health in RA patients. The use of well-validated clinical measures, such as the DAS28, PHQ-9, and GAD-7, provided robust assessments of patient outcomes. Moreover, the inclusion of a diverse sample in terms of age, gender, and disease duration allowed for a more comprehensive analysis of how diet affects different aspects of RA.

CONCLUSION

In conclusion, the results suggest that dietary interventions could be a valuable component of RA management, contributing not only to the reduction of disease activity but also to the improvement of mental health. Healthcare providers should consider incorporating dietary counseling into the standard care of RA patients, promoting adherence to diets rich in anti-inflammatory foods, such as omega-3 fatty acids, fruits, vegetables, and whole grains. Future research should aim to address the limitations of this study by conducting longitudinal and interventional studies to establish causal links and explore the mechanisms underlying the relationship between diet and RA outcomes (Ranganath et al., 2023; Matsumoto et al., 2021).

REFERENCES

1. Sköldstam L, Hagfors L, Johansson G. An Experimental Study of a Mediterranean Diet Intervention for Patients With Rheumatoid Arthritis. Ann Rheum Dis. 2003;62(3):208-14.
2. Badsha H. Role of Diet in Influencing Rheumatoid Arthritis Disease Activity. Open Rheumatol J. 2018;12:19.
3. Forsyth C, Kouvari M, D'Cunha NM, Georgousopoulou EN, Panagiotakos DB, Mellor DD, et al. The Effects of the Mediterranean Diet on Rheumatoid Arthritis Prevention and Treatment: A Systematic Review of Human Prospective Studies. Rheumatol Int. 2018;38(5):737-47.
4. Tedeschi SK, Bathon JM, Giles JT, Lin TC, Yoshida K, Solomon DH. Relationship Between Fish Consumption and Disease Activity in Rheumatoid Arthritis. Arthritis Care Res. 2018;70(3):327-32.
5. Picchianti Diamanti A, Panebianco C, Salerno G, Di Rosa R, Salemi S, Sorgi ML, et al. Impact of Mediterranean Diet on Disease Activity and Gut Microbiota Composition of Rheumatoid Arthritis Patients. Microorganisms. 2020;8(12):1989.
6. Vadell AK, Bärebring L, Hulander E, Gjertsson I, Lindqvist HM, Winkvist A. Anti-Inflammatory Diet in Rheumatoid Arthritis (ADIRA): A Randomized, Controlled Crossover Trial Indicating Effects on Disease Activity. Am J Clin Nutr. 2020;111(6):1203-13.
7. Ranganath VK, La Cava A, Vangala S, Brook J, Kermani TA, Furst DE, et al. Improved Outcomes in Rheumatoid Arthritis With Obesity After a Weight Loss Intervention: Randomized Trial. Rheumatology. 2023;62(2):565-74.
8. Matsumoto Y, Shivappa N, Sugioka Y, Tada M, Okano T, Mamoto K, et al. Change in Dietary Inflammatory Index Score Is Associated With Control of Long-Term Rheumatoid Arthritis Disease Activity in a Japanese Cohort: The TOMORROW Study. Arthritis Res Ther. 2021;23(1):10.
9. Tedeschi SK, Bathon JM, Giles JT, Lin TC, Yoshida K, Solomon DH. Relationship Between Fish Consumption and Disease Activity in Rheumatoid Arthritis. Arthritis Care Res. 2018;70(3):327-32.
10. Picchianti Diamanti A, Panebianco C, Salerno G, Di Rosa R, Salemi S, Sorgi ML, et al. Impact of Mediterranean Diet on Disease Activity and Gut

Microbiota Composition of Rheumatoid Arthritis Patients. Microorganisms. 2020;8(12):1989.

11. Vadell AK, Bärebring L, Hulander E, Gjertsson I, Lindqvist HM, Winkvist A. Anti-Inflammatory Diet in Rheumatoid Arthritis (ADIRA): A Randomized, Controlled Crossover Trial Indicating Effects on Disease Activity. Am J Clin Nutr. 2020;111(6):1203-13.

12. Sköldstam L, Hagfors L, Johansson G. An Experimental Study of a Mediterranean Diet Intervention for Patients With Rheumatoid Arthritis. Ann Rheum Dis. 2003;62(3):208-14.