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Association between anti-inflammatory diet score, brain fog and digestive discomfort among young adult females

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Abstract
Although gut-brain axis regulates both gastrointestinal health and cognitive function, there is limited research on relation between dietary habits, brain fog and gastrointestinal health. This study aimed to evaluate the dietary patterns of young adult females, prevalence of subjective brain fog symptoms and digestive discomfort symptoms and to analyse the correlation between these variables. A cross-sectional study was conducted among 100 young female college students. Data was collected using a detailed structured questionnaire to calculate scores for anti-inflammatory diet adherence and severity of brain fog and digestive discomfort symptoms. The findings of the study revealed weak negative correlations between anti-inflammatory diet score and brain fog ($r = -0.1326$, $p = 0.184$) and digestive discomfort symptoms ($r = -0.02249$, $p = 0.822$), while a very weak positive correlation was observed between brain fog and digestive discomfort symptoms ($r = 0.04659$, $p = 0.642$). However, none of the associations were statistically significant ($p > 0.05$). The present study concludes that anti-inflammatory dietary patterns showed no statistical association with brain fog and digestive discomfort symptoms among participants, highlighting the need for future research.

Keywords: Brain fog, anti-inflammatory diet, gastrointestinal health, gut-brain axis, cognitive health

Introduction

Adolescence is a critical phase of physical, psychosocial and neurocognitive development, during which dietary choices can influence the long-term health outcomes [12]. However modern dietary patterns among young adults are increasingly characterized by consumption of sugary and processed foods and lower intake of healthy foods such as fruits and vegetables. Such dietary choices may contribute to systemic inflammation, oxidative stress affecting both physical as well as neurocognitive health. Therefore, understanding the relation between dietary patterns, inflammation and cognitive health is important.

Inflammation is natural protective response against the toxins, pathogens and environmental factors, but prolonged inflammation can be associated with poor diet, oxidative stress which can contribute to chronic systemic inflammation and can affect the cognitive health [14]. An anti-inflammatory diet rich in omega -3 fatty acids, polyphenols, antioxidants and other bioactive compounds may help regulate inflammatory pathways and may also reduces oxidative stress. Anti-inflammatory dietary patterns have been associated with reduced inflammatory biomarkers and potential protective effects on brain health [8, 17].

Brain fog is a term refers to the range of cognitive symptoms such as difficulty in concentrating, reduced mental clarity, impaired memory and problems in multitasking [15]. Although the precise etiology of this symptom is not fully understood but current understanding suggests that immune dysregulation, inflammation, oxidative stress, neuroinflammatory processes are contributing factors. Lifestyle factors such as insufficient sleep or sleep deprivation can influence cognitive function by promoting inflammation and oxidative stress [6, 18]. Brain fog is heavily linked to neuroinflammation. Neuroinflammation may contribute to altered neuronal signalling and cognitive symptoms. These neuroinflammatory responses are believed to play significant roles in the progression of neurological symptoms, including brain fog [2].

A balanced dietary pattern that includes a variety of foods and nutrients has been associated with better cognitive outcome and may help prevent cognitive decline across lifespan [9]. A study conducted by Pilato *et al.* found that higher consumption of fruits, seafood, optimal fluid intake, nutritionally balanced diet was strongly correlated with the better visual memory and cognitive performance in college students [10]. Mechanistically consumption of anti-inflammatory diet rich in antioxidants, omega 3 fatty acids, fibre found as a foundation to manage brain fog [2].

The consumption of anti-inflammatory diet totally modulates the gut microbiota, supporting the production of healthy bacteria by reducing harmful bacteria to prevent Dysbiosis. It has been proven in most of the studies that diets rich in fibre, polyphenols, plant derived antioxidants, prebiotics fuel the beneficial microbes. When diet induced dysbiosis occurs, immune regulation alterations takes place gradually leading to lower grade intestinal inflammation [5]. Conversely when individuals fail to take a proper nutritionally balanced diet, this gut inflammation causes various gastrointestinal symptoms such as bloating, abdominal pain, chronic pain, constipation etc. Irregular food habits and irritable food consumption like proinflammatory foods shares a relation with the

gastrointestinal symptoms proven in a cross-sectional study [16].

The gut brain axis is a bidirectional communication network between the gastrointestinal system and central nervous system involving the neural, immune and metabolic pathways. The term microbiota-gut-brain axis highlights the role of gut microbiota interacting with brain functions, according to preliminary research. Any changes or disruptions in the gut function and immune signalling can directly influence the brain function by which it can show different cognitive symptoms across different conditions. Increasing evidence suggests that the gut microbiome significantly influences brain function, behaviour, and potentially cognitive processes.

Despite linking nutrition with systemic inflammation, several gaps remain within previous research literatures. Existing research has mainly focused on dietary inflammatory patterns and cognitive outcomes in older women, postmenopausal women and clinical groups while research among younger adult population remains limited. Furthermore, nutritional research has rarely examined relation between these variables such as dietary patterns, cognitive health and digestive discomfort symptoms. Most previous studies have focused on any particular food or nutrient and their separate effect on either cognitive health or digestive discomfort. Therefore, investigating the relationship between anti-inflammatory dietary patterns, brain fog, and digestive discomfort among young adults may provide useful insight into the potential role of diet in cognitive and gastrointestinal health. The increase in the consumption of inflammatory foods and occurrence of cognitive dysfunction symptoms and digestive discomfort symptoms among young adults highlights the need for the study for better understanding of role of diet. Therefore, the present study aimed to examine the association between anti-inflammatory diet score, brain fog and digestive discomfort symptoms among young adult females.

Materials and methods

A cross sectional study was conducted among female college students aged 18-25 (N=100) at Veeranari Chakali Ilamma Women's University hyderabad including only postgraduate students, who were willing to participate. Individuals who were diagnosed with any neurological, chronic gastrointestinal conditions and unwilling were excluded.

Data Collection and Assessment Tools

Data were collected using self-structured questionnaire containing demographic details, brain fog symptoms, digestive discomfort symptoms, perceived impact and cross symptom correlation, food frequency questionnaire containing anti-inflammatory and proinflammatory foods.

Brain fog assessment tool: Evaluated using a tool adopted from brain fog scale developed by Debowska [7] and cognitive failure questionnaire developed by Broadbent [4].

Digestive discomfort symptoms assessment tool: Evaluated using a self-structured tool based on Svedlund 1988 [13].

Scoring

Brain fog and digestive discomfort symptoms were scored on a 5-point Likert scale (0= never to 4= always) where higher summed scores reflected greater symptom severity.

Anti-inflammatory diet score: food intake frequency was evaluated by scoring (Daily = 4, Once in a month=2, 1-2times per week=3, never =1) to the anti-inflammatory foods and reverse scoring was done for proinflammatory foods. To evaluate net dietary score, a scoring framework was adapted from Azavedo Garcia study [1]. While the original framework subtracted (Sum of pro-inflammatory-Sum of anti-inflammatory) to get total dietary score. Meanwhile the present study intentionally inverted this equation (sum of anti- inflammatory- sum of pro-inflammatory = net dietary score), so that higher cumulative dietary scores represents greater adherence to anti-inflammatory diet.

Net dietary score = Sum of Anti-inflammatory score – Sum of Proinflammatory score Data was analysed using JASP software. Spearman's rank correlational method was used to examine the association between anti-inflammatory diet score, brain fog and digestive discomfort symptoms. Statistical significance was defined at $p < 0.05$.

Ethical considerations: Participation was voluntary. Prior to completion of questionnaire, participants were informed about the purpose of the study and signatures were taken at the end of the questionnaire. Participants personal information were kept confidential throughout the study.

Results and discussion

Demographic and lifestyle history

A total of 100 students aged 18-25 participated in this study. The majority of participants were 21-23 years (85%), among them 51% were hostellers and 49% were day scholars. Lifestyle evaluation revealed that largest group of students (44%) get 6-7hours of sleep, while 25% of students are surviving on 5- 6hours of sleep. Regarding physical activity of 51% of participants engaged in moderate activity, 37% were sedentary and remaining 12% were physically active.

Prevalence of brain fog, digestive discomfort symptoms and net dietary scores

The brain fog score was calculated by summing up each individual's response frequency for the ten subjective brain fog symptoms.63% of the student population fall into moderate category, while only 5% scores within the high severity category. Conversely 32% of the remaining population has reported a low-level brain fog symptom. For digestive discomfort symptoms score, 71% of the students reported low range of symptoms, while 28% of students showed moderate level of digestive discomfort symptoms and in only 1% of high range of symptoms were observed. The net dietary score adherence measures the overall of student's diet. 65% of student population falls into the moderate category of Composite anti-inflammatory dietary score. The remaining 16% of students falling into low category and 19% in category high net range category of Composite anti-inflammatory dietary score.

Table 1: Distribution of brain fog, digestive discomfort symptoms and net anti-inflammatory diet scores (N=100)

Variables	Severity/ Adherence	Score ranges	Frequency	Percentage
Brain fog symptoms	Low	0-13	32	32%
	Moderate	14-26	63	63%
	High	27-40	5	5%
	Total		100	100%
Digestive discomfort symptoms	Low	0-12	71	78%
	Moderate	13-24	28	21%
	High	25-36	1	1%
	Total		100	100%
Net dietary scores	Low	35-62	16	16%
	Moderate	63-90	65	65%
	High	91-119	19	19%
	Total		100	100%

Perceived impact and cross symptom correlation

Evaluation of self reported gut brain symptom interaction revealed a strong cross symptom impact among participants. 68% of the participants reported reduction in concentration on the days they experience gastrointestinal symptoms. While, 63% of students observed stress induced gastrointestinal symptoms during academic pressure, which highlights the bidirectional communication network.

Spearman's rank correlational analysis between the variables

Weak negative correlations were observed between anti-inflammatory diet score and brain fog symptoms (rho = -0.1326; p = 0.184) and between anti-inflammatory diet score and digestive discomfort symptoms score (rho = -0.02249; p = 0.822). Which clearly indicates an inverse relationship. However, it did not reach statistical significance. While the association between brain fog scores and digestive discomfort symptoms score showed a weak positive correlation (rho =0.04659; p =0.642), suggesting that the both variables rise together. However, the correlation was not statistically significant.

Table 2: Correlational analysis of study variables (N =100)

Variables	Spearman's (rho value)	P-value	Statistical significance
Anti-inflammatory diet score and brain fog score	-0.1326	0.184	Non-significant
Anti-inflammatory diet score and digestive discomfort symptoms score	-0.02249	0.822	Non- significant
Brain fog score and digestive discomfort symptoms score	0.04659	0.642	Non-significant

These findings (association between anti-inflammatory diet score and brain fog) are consistent with previous study Altinsoy *et al*., 2025 who also reported no significant association between dietary patterns and brain fog. This can be due to limited variations of anti-inflammatory dietary score and brain fog symptoms among participants and also other lifestyle factors like sleep, physical activity which may also influence the cognitive function and affect the observed relationship between diet and brain fog. Where as Patrick *et al*., 2023 also observed an association between gastrointestinal symptoms and cognition function. In present study, very weak positive correlation was observed between brain fog and digestive discomfort symptoms score. These findings support the mechanism of gut- brain axis. Whereas non-significance may be due to limited variations in the reported symptoms scores and also the other cofounding lifestyle factors within the sample population such as sleep patterns & physical activity.

Conclusion

Although the observed correlations were not statistically significant, the directional correlations observed in the present study provides an interesting perspective on the possible relationship between diet, cognitive symptoms and gastrointestinal symptoms. The weak inverse correlations between anti-inflammatory diet score and both brain fog and digestive discomfort symptoms suggests a direction for the future research. The weak positive correlation between brain fog score and digestive discomfort symptoms is also consistent with the framework of gut-brain axis, however no statistical significance was observed in this study. These non-significant associations may be attributed to cofounding lifestyle factors such as sleep deprivation, physical activity, academic stress which might have a stronger influence these symptoms than di*et al*one.

Limitations of this study include as it is a cross-sectional study, symptoms may vary according to time, self reported questionnaires can subject to recall bias and it is limited to only female population. Future research should employ longitudinal studies, with larger sample size, evaluating the biomarkers, a comparative study of dietary intake between hostellers and day scholars.

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