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The Relationship of Plant and Animal Protein Intake with Mental Health in Healthy Adults

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Abstract

Background and Objectives: Mental impairment disrupt the brain's regular performance, as the nutrition has playing a crucial role in its prevention. Amino acids, fundamental components of proteins, serve as vital precursors to neurotransmitters, the dysfunction of which is closely linked to various brain disorders. The aim of this study was to explore the association between the consumption of different categories of food proteins derived from plants and animals and overall mental health status.

Methods: The current cross-sectional study involved 200 healthy adults selected through random sampling from the Sabzevar Persian cohort study. Assessment of their mental health was done using a 28-items General Health Questionnaire (GHQ), as well as dietary information was gathered using a food frequency questionnaire (FFQ), which was analyzed by N4 nutritional software to determine the daily quantity of protein obtained from animal and plant sources. Statistical analysis was performed utilizing SPSS 20 software.

Results: Totally, 124 (62%) of the subjects were male and 76 (38%) were female. Notably, the findings indicated a negative relationship between processed meat consumption and mental health ($r=-0.114$, $P<0.05$); however, no significant association was detected between the mental health and consumption of animal or plant-based proteins.

Conclusion: It is concluded that the intake of animal and plant proteins except processed meat does not impact mental health of apparently healthy subjects.

Keywords: Mental Health, Nutrition, Plant-Based Protein, Animal-Based Protein

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1. Introduction

Mental health is a crucial and influential aspect of health systems and is becoming a major public health problem worldwide (1). The burden of mental disorders, such as depression and anxiety disorders, accounts for approximately 13% of the total global disease burden (2). The World Health Organization (WHO) defines mental health as a dual construct that includes negative mental health – the absence of mental disorders, symptoms and complications – and positive mental health, which embodies emotional well-being and positive personality traits such as self-esteem, adaptability, integrity and self-reliance (3). WHO global projections suggest that a quarter of the world's population will suffer from psychiatric disorders during their lifetime (4). Notable studies on the prevalence of mental illness in Iran show a worrying increase in the incidence of psychiatric

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↑*Question* *To explore the association of different food protein sources intake and overall mental health status.*

Findings *There was a negative relationship between processed meat consumption and mental health ($r=-0.114$, $P<0.05$); however, no significant association was detected between the mental health and consumption of total animal or plant-based proteins.*

→*Meaning* *Consumption of animal and plant proteins except processed meat does not impact mental health of apparently healthy subjects.*

disorders, exceeding the rates observed in other countries, reaching 39.6% (5). The need to address the increasing prevalence of mental disorders arises from their detrimental impact on quality of life, exacerbation of physical ailments, increased disability and mortality rates, and the potential to cause social problems such as reduced productivity, suicide or crime. This poses problems for both the individual as well as a significant burden on society (6).

Findings from studies focusing on biology and epidemiology highlight how important diet is in managing and preventing mental health problems (7, 8). As an essential part of food, proteins facilitate a variety of body processes, from development to the production of hormones and enzymes (9). There are two types of protein sources including plant-based and animal-based. About 25% of the protein required should come from animal products (10). Whereas animal protein comes from meat, dairy, eggs, and aquatic animals, plant-based protein is found in foods like whole grains, legumes, nuts, and seeds. Animal protein sources have a higher biological value and are richer in essential amino acids for the body than plant protein (9). A number of studies suggest that consuming more proteins derived from animals is associated with a higher risk of developing chronic illnesses like diabetes, obesity, coronary artery disease, and cancer (11, 12). Several investigations have indicated a correlation between intake of particular nutrients including calcium and dairy products with mental well-being (13-15). Conversely, some studies have not found any significant link between protein consumption from grains, processed foods, and legumes, and mental health (16). The association of fruits and vegetables with mental health remains inconclusive (17, 18). Given the limited data regarding the impact of dietary protein on mental health, this research endeavors to explore the correlation between plant and animal protein consumption and mental health among healthy adult individuals.

2. Materials and Methods

The protocol of current cross-sectional study was approved by the ethical committee of Sabzevar University of Medical Sciences, Sabzevar, Iran (reference number: IR.MEDSAB.REC.1402.02). All participants were asked to sign informed consent forms. It was explained to all the subjects that the information obtained from them will remain confidential and will be used only for conducting the study.

This study was conducted on 200 apparently healthy individuals who were referred to the baseline phase of the Sabzevar Persian Cohort Study (SPCS) in 2021. A random sampling method was used to select the participants from all the 4500 subjects of this center. After selecting the participants, all the clinical characteristics were checked to make sure they were healthy. Inclusion criteria were adults over 18 years of age participating in the Persian cohort study, while exclusion criteria comprised pregnant and lactating females, individuals using protein supplements, drug and cigarette users, patients with psychiatric conditions, and those afflicted with any chronic disorders. Data regarding the dietary patterns and consumption of animal and plant-based proteins among these individuals were gathered utilizing food frequency questionnaire (FFQ). The FFQ is a 115-item semi-quantitative questionnaire that includes foods commonly consumed by Iranians, local foods, and standard serving sizes. It was completed by trained nutritionists to assess dietary intake in face-to-face interviews.The reliability and validity of the FFQ have previously been approved in a healthy Iranian population(19). Subsequently, the information was converted into grams using household measurements and inputted into Nutritionist IV nutritional software to determine the quantity of protein derived from animal and plant sources, along with the specific type of protein consumed. The consumed protein was categorized in 10 groups including dairies, chickens, meat, nuts, beans, bread, and grains. Furthermore, the participants' mental health status was evaluated by administering the 28-item General Health Questionnaire (GHQ). The GHQ assesses mental health over the last month on four components, each of which contain seven items: somatic symptoms (items 1–7), anxiety/insomnia (items 8–14), social dysfunction (items 15–21), and severe depression (items 22–28). Many studies in Iran confirmed The validity and reliability of GHQ-28. Participants were briefed on each indicator within the GHQ during the interview, followed by inquiries regarding each indicator (20-22). The anthropometric indices including weight, height, body mass index (BMI), waist circumference (WC), hip circumference (HC), waist hip ratio (WHR) were measured using standard methods.

The data was analyzed using SPSS software version 20, with the normality assessment conducted through the Kolmogorov-Smirnov test. Mean and standard deviation were employed to represent quantitative data, while number and percentage were used for qualitative data. To evaluate the differences between tertiles of animal and plant-based proteins one-way ANOVA test was used. The investigation into the interplay between dependent and independent variables was carried out using Pearson's and Spearman's correlation tests. Furthermore, logistic regression tests were utilized to ascertain the likelihood of experiencing mental health problems.

3. Results

Among the 200 individuals participated in current study, 124 (62%) were male, whereas 76 (38%) were female. The mean age of the participants was 47.32 ± 8.08 years, with an age range from 35 to 68 years. Moreover, the mean years of education among the participants amounted to 12.19 ± 3.78 years, ranging from 4 to 18 years. Except gender, there were not any differences in demographic characteristics of study participants in tertiles of plant and animal protein sources. The characteristics findings of participants are detailed in Table 1. Further, daily consumption of proteins in tertiles of plant and animal sources is shown in Table 1. Participants in the top tertile of plant protein had consumed more amounts of diary, nuts, egg, and fruits. Moreover, participants who were in the highest tertile of animal protein sources have higher intake of all the food items except egg and processed meat.

The mental health of the participants was 12.35± 5.34

Table 1. Demographic characteristics and daily intake of dietary protein sources in study subjects

Variable	Total	Plant protein				Animal protein			
		T1 ≤50.5 (n=70)	T2 50.6-77.9 (n=64)	T3 ≥78.0 (n=66)	P.value**	T1 ≤26.5 (n=68)	T2 26.6-35.7 (n=64)	T3 ≥35.8 (n=68)	P.value**
Age (years)	47.32±8.08	47.14±7.60	48.47±7.37	46.39±9.16	0.336	47.50±7.46	47.75±9.01	46.73±7.85	0.754
Education (years)	12.19± 3.78	12.06±3.10	12.34±4.57	12.18±3.65	0.909	12.12±3.88	12.87±3.38	11.62±3.98	0.159
WSI	0.39± 0.08	0.39±0.07	0.46±0.09	0.31±0.02	0.605	0.29±0.08	0.51±0.07	0.37±0.09	0.326
Gender* Male	124 (62)	38 (54)	44 (69)	42 (64)	0.062	36 (53)	42 (65)	46 (68)	0.032
Female	76 (38)	32 (46)	20 (31)	24 (36)		32 (47)	22 (35)	22 (32)	
Weight (kg)	74.03± 12.86	73.78±11.69	75.80±15.27	72.57±11.41	0.354	76.35±12.31	71.95±12.49	73.68±13.56	0.141
Height (cm)	161.53±9.84	161.12±9.73	163.29±10.81	160.26±8.82	0.195	163.72±9.91	160.22±9.28	160.58±10.05	0.076
BMI (kg/m2)	28.34±4.07	28.44±3.97	28.30±4.37	28.27±3.93	0.967	28.46±3.75	28.03±4.23	28.52±4.26	0.758
WC (cm)	97.48±9.48	97.91±8.58	97.98±10.17	96.53±9.77	0.612	98.03±8.64	97.64±9.34	96.76±10.46	0.730
Diary (g/day)	372.23±206.28	290.92±170.13	364.37±176.29	467.89±230.13	<0.001	178.21±65.17	337.30±50.32	600.88±165.32	<0.001
Nuts (g/day)	8.71±5.71	6.99±4.39	8.69±4.75	10.56±7.13	0.001	8.26±5.24	7.23±4.10	10.56±6.92	0.002
Legumes (g/day)	46.44±29.31	21.66±7.30	41.49±10.34	77.51±28.37	<0.001	32.65±19.32	42.37±21.67	64.05±34.84	<0.001
Whole grains (g/day)	214.25±119.55	163.02±67.88	205.21±122.32	277.35±131.96	<0.001	162.81±71.60	222.77±113.17	257.67±143.57	<0.001
Meat (g/day)	78.24±30.08	70.13±24.67	75.12±19.74	89.87±39.09	<0.001	70.84±20.36	76.31±27.70	87.46±37.48	0.004
Egg (g/day)	34.16±16.03	29.56±13.40	35.00±15.60	38.22±17.88	<0.001	27.16±12.79	37.95±13.97	37.59±18.44	<0.001
Processed meat (g/day)	3.48±1.52	1.78±1.19	1.69±1.08	7.04±1.22	0.003	3.28±1.75	4.00±1.75	3.20±1.33	0.893
Vegetables (g/day)	466.42±242.66	485.07±266.13	411.84±230.45	499.57±221.81	0.087	466.26±246.67	444.13±251.61	487.55±231.50	0.592
Fruits (g/day)	498.94±339.81	526.20±304.00	568.94±407.91	29.00±18.60	0.511	513.21±332.50	538.12±361.80	541.40±368.29	0.880

All the data expressed as mean± standard deviation
*Shown as number (percent)
**Based on one-way ANOVA test and Chi-square test for categorical variable (gender)

which expressed a healthy status. Table 2 has shown the average mental health among tertiles of daily intake of plant and animal-based proteins. As shown, there were not any significant differences in mental health of participants in three categories of plant or animal-based proteins (P>0.05).

The Pearson correlation has indicated a negative relationship between processed meat consumption and mental health (r = -0.144, P<0.05) (Table 3).

Table 4 has determining the chance of adverse mental health occurrence with the intake of plant and animal proteins. As shown, in all the models and after considering the confounding factors there were not any significant association between these dietary items intake and mental health.

4. Discussion

This study was done on 200 healthy subjects to investigating the relationship between the consumption of various dietary proteins of plant and animal origin with mental health. According to the results of the present study, processed meat intake was inversely correlated with mental health. Further, no significant relationship was found between the consumption of animal or plant proteins with mental health.

Evidence reveals the role of diet in onset, progression, and control of mental disorders. The relationship of processed meat intake with mental health was also assessed in recent studies. In line with our study, a dose-responsive meta-analysis has detected that intake of ultra-processed foods was related to increasing depressive mental health status risk in 260,385 participants (23). Lane et al. has also reported the same result (24). Processed foods have high levels of energy as well as, low amounts of fibers, antioxidants, essential vitamins and minerals. Then, it is suggested that high intake of processed foods may have negative effects on mental status thorough destructive changes on inflammation, oxidative stress, and the gut microbiome (25, 26). Most of the processed meat has emulsifier and antimicrobial ingredients such as carboxymethylcellulose and polysorbate-80 that may reduce diversity of gut microbiota composition and also disrupt their function thorough reduction of short-chain fatty acids and free amino acids contents. Alteration of gut microbiota composition is a main factor in increasing inflammatory responses (27, 28). A high amounts of cytokine interleukin-6 in the plasma and cerebral cortex are associated with negative mental status in rats (29). There is need for further study to evaluate the exact involved mechanisms.

This study indicated that intake of plant or animal proteins have not any association with mental health. Inversely to our results, in another study has shown that consumption of protein from animal sources was associated with mental disorders which was conducted on 3,349 older people (30). In addition, in a clinical trial study of 18 people who were divided into two groups, it was found that the group that consumed plant-based meals during the

Table 2. Mental health of participants across tertiles of animal and plant proteins

Variables	Total	Plant protein				Animal protein			
		T1 ≤50.5 (n=70)	T2 50.6-77.9 (n=64)	T3 ≥78.0 (n=66)	P.value*	T1 ≤26.5 (n=68)	T2 26.6-35.7 (n=64)	T3 ≥35.8 (n=68)	P.value*
GHQ	12.35±5.35	13.17±6.30	11.25±4.79	12.54±4.61	0.108	12.73±5.68	12.16±5.01	12.15±5.37	0.767

*P.values based on one-way ANOVA test

Table 3. The correlation of Food items consumption with mental health of study participants

Variables	r	P.value*
Diary (g/day)	-0.058	0.415
Nuts (g/day)	-0.036	0.614
Legumes (g/day)	-0.018	0.796
Whole grains (g/day)	-0.015	0.835
Meat (g/day)	-0.043	0.545
Egg (g/day)	0.009	0.894
Processed meat (g/day)	-0.144	0.041
Vegetables (g/day)	-0.051	0.476
Fruits (g/day)	0.050	0.481

*Based on Pearson analysis

Table 4. Crude and multivariable-adjusted odds ratios (95% CIs) for mental health across tertiles of plant and animal proteins

Variables	Plant protein				Animal protein			
	T1 ≤50.5 (n=70)	T2 50.6-77.9 (n=64)	T3 ≥78.0 (n=66)	p.value	T1 ≤26.5 (n=68)	T2 26.6-35.7 (n=64)	T3 ≥35.8 (n=68)	p.value
Crude	1.020 (0.960-1.084)	0.948 (0.882-1.018)	1	0.515	1.021 (0.958-1.087)	1.000 (0.937-1.068)	1	0.526
Model 1*	1.022 (0.960-1.087)	0.947 (0.882-1.017)	1	0.499	1.019 (0.956-1.086)	0.995 (0.932-1.063)	1	0.568
Model 2**	1.022 (0.961-1.087)	0.948 (0.883-1.018)	1	0.494	1.018 (0.955-1.085)	0.996 (0.933-1.065)	1	0.576

Highest tertile consider as the reference group, Based on Multinomial Logistic Regression
* Adjusted for age, gender and education level
** Adjusted for age, gender, education level and WSI

experiment had higher levels of brain tryptophan and tyrosine than those who ate meals rich in animal resources (31). In another study among Iranian subjects has reported that high intake of animal proteins predispose individuals to mental disorders, but this association was not seen in plant proteins (32). In similar studies, it was also shown that mental disorders are associated with higher consumption of animal protein in a sample of 489 Iranian women (33). Red meat is a good source of protein, zinc, iron, vitamin B6 and vitamin B12, and only a small serving of red meat can provide a sufficient amount of these essential nutrients for the human body (34). However, it also contains cholesterol and saturated fatty acids, which are risk factors for chronic diseases (35). Previous studies have shown a significant relationship between red meat consumption, type 2 diabetes and cardiovascular risk factors (36). Red meat consumption was positively associated with higher BMI; higher prevalence of obesity, and less physical activity in a review of cohort studies, and importantly, these factors may be associated with poorer mental health due to greater oxidative stress, systemic inflammation, and dysregulation of the HPA axis (37). The contrary results of our study can be due to the small sample size and its cross-sectional nature. It is suggested that the future randomized control trials studies use more valid methods to assess the actual intake of the protein sources in daily diet of the participants.

The present study can increase our knowledge about the relationship between protein intake and psychological function. However, some limitations should be noted. First, recall bias in reporting dietary intake may have influenced the results. Second, this study was only conducted on people aged 35 to 68, which affects generalizability to a larger population. Third, the GHQ is a self-report scale used to measure the severity of symptoms of anxiety, stress, and depression, and is useful for screening rather than diagnosis. Forth, we couldn't distinct between red and white meat consuption according using the FFQ.

5. Conclusion

In conclusion, we found that processed meat intake have negatively affected the mental health. Also, consumption of animal and plant-based proteins did not have a different effect on mental health. Future longitudinal studies with a larger population are needed to investigate the exact impact of variuos protein sources on mental health.

Ethical Statement

The protocol of study was approved by the ethical committee of Sabzevar University of Medical Sciences, Sabzevar, Iran (reference number: IR.MEDSAB.REC.1402.021).

Authors' Contributions

EF and AK: study conception and design, RJ and MY: data collection, EF: analysis and interpretation of results, RJ, MKS, and AK: manuscript preparation, EF: manuscript editing.

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Conflict of Interests

The authors declare that they have no competing interests.

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