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Dietary intake of nuts, oilseeds and vegetables and its association with cognitive health among young adults: A cross- sectional study

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Abstract
Background: Cognitive health includes memory,attention, and decision making is increasingly global concern by rising rates of neurodegenerative disorders.Plant based foods such as nuts, oilseeds, fruits, and vegetables,rich in antioxidants, healthy fats,and essential micronutrients, may reduce oxidative stress and neuroinflammation.However, their role in cognitive development among young adults remains underexplored.
Objectives: To assess dietary patterns of nuts, oilseeds, fruits and vegetables and examine their association with cognitive performance in young adults.
Materials and Methods: A cross sectional observational study was conducted among 160 young adults (18-25 years) in Pune, Maharashtra. Data were collected using a structured questionnaire comprising personal and sociodemographic information,the Kuppuswamy Socioeconomic scale, a food frequency questionnaire (FFQ), a 24-hour dietary recall,and the Montreal Cognitive Assessment (MoCA). Statistical analysis was performed using SPSS v.16.0, with Kendall's tau b correlation to find out the associations.
Results: Among 160 participants (50%Male, 50%Female), 114(71.2%) showed normal cognitive function and 46(28.8%) showed mild cognitive impairment (MCI). Almond consumption showed a significant positive association with cognitive performance (p=0.025). Among vegetables Cabbage (p=0.001), Cluster beans (p=0.020) and Fenugreek leaves (p=0.036) also demonstrated significant positive association. Cashews, pistachios and walnuts showed positive but statistically non-significant trends.
Conclusion: The plant -based foods notably almonds, cabbage, cluster beans, and fenugreek leaves are significantly associated with better cognitive performance in young adults. These findings highlight the importance of dietary strategies during early adulthood.

Keywords: Cognitive function, nuts and oilseed, vegetables, young adults, mild cognitive impairment, MoCA, dietary patterns

Introduction

Cognitive health comprises functions such as memory, attention, processing speed, learning, and decision making is increasingly recognised as a key determinant of healthy and successful ageing [1]. With the global population ageing, the prevalence of neurodegenerative disorders such as Alzheimer's disease and dementia is rising, making the preservation of cognitive function a major public health priority [2]. In this context, researchers have turned their attention to modifiable lifestyle factors, especially diet, as a potential strategy for delaying or attenuating age-related cognitive decline [3]

A growing body of observational and experimental evidence indicates that dietary patterns rich in plant based foods including nuts, oilseeds, fruits and wholegrains are associated with better preserved cognitive performance and a lower risk of cognitive impairment and dementia [4, 5]. These foods are rich sources of essential nutrients such as vitamin E, vitamin C, polyphenols, flavonoids, carotenoids, healthy fats notably omega -3 polyunsaturated fatty acids and monounsaturated fatty acids, dietary fibre, and minerals like magnesium and potassium [6, 7]. These compounds exert neuroprotective effects by reducing oxidative stress, modulating neuroinflammation, improving endothelial and vascular function, and supporting neuronal integrity.

Despite accumulating evidence for the beneficial effects of plant based diets on cognition, there remains a paucity of research focusing specifically on young adults (18-25 years), particularly within Indian populations where dietary patterns and lifestyle are rapidly changing.This age group is critical, as a nutritional choices during this period directly influence cognitive efficiency, concentration, and mental resilience, which set the foundation for long term brain health. Identifying specific food groups that are associated with better cognitive performance can enable targeted nutrition education campaigns and campus based interventions that are acceptable to young adults.

Aim and Objectives

Aim: To study the association between the consumption of nuts, oilseeds, and vegetables and cognitive health among young adults aged 18-25 years.

Objectives

- To study the personal and sociodemographic characteristics of the participants.
- To study the dietary pattern of nuts, oilseeds, and vegetables using a Food Frequency Questionnaire (FFQ).
- To study the cognitive function of participants using the Montreal Cognitive Assessment (MoCA)tool.
- To study the association between dietary patterns of these food groups and cognitive performance scores.

Hypothesis

H_0 (Null): There is no significant association between dietary intake of nuts, oilseeds, and vegetables and cognitive performance in young adults.

H_1 (Alternative): There is a significant association between dietary intake of nuts, oilseeds, and vegetables and cognitive performance in young adults.

Materials and Methods

Type of Study

This study is a Cross sectional observational design to assess the association between dietary intake of nuts, oilseeds, fruits, and vegetables and cognitive health among young adults.

Study Locale

The study was conducted in Pune, Maharashtra, which provides a diverse population of young adults with different dietary habits, educational background, and lifestyles. Participants were selected from various colleges and residential areas within Pune to ensure representation of students and non-student population from different sociodemographic backgrounds.

Sample Size

The sample size was determined using Cochran's formula based on a previous study reporting a prevalence of 11.2% for cognitive impairment in young adults [15]:

$$n=Z^2p(1-p)\div d^2=(1.96)^2\times0.112\times0.888\div(0.05)^2 \sim153$$

A total of 160 participants were enrolled to allow for incomplete data and improve precision of estimates.

Eligibility Criteria

Inclusion: Young adults aged 18-25years; free from known neurological or psychiatric disorders; not on medication influencing cognitive health; willing to provide informed consent.

Exclusion: Individuals below 18 or above 25 years; those with chronic illnesses; individuals on specialized therapeutic diets or with allergies to study foods; those unwilling to participate.

Sampling Technique

A Purposive sampling technique was used to ensure adequate representation of different subgroups like age, gender, educational background.

Ethical Considerations

The study was conducted in accordance with the principles of the declaration of Helsinki (1964) and its amendments. Written informed consent was obtained from all participants. Confidentiality of participant information was maintained, and participants were allowed to withdraw from the study at any stage.

Tools for Data Collection:

Section 1: Personal Information

Demographics including age, educational status, height, weight.

Section 2: Dietary Habits

Includes Food preferences, meal frequency and meal skipping habits.

Section 3: Kuppuswamy Socioeconomic Scale

Including the education and occupation of the head and family income.

Section 4: Food Frequency Questionnaire (FFQ) and 24-Hour Dietary Recall

The frequency of consumption of nuts, oilseeds, fruits and vegetables with its actual daily intake and portion sizes.

Section 5: Montreal Cognitive Assessment (MoCA)

A standardized tool evaluating attention, memory, language, executive function, visuospatial abilities, abstraction and orientation.

Pilot Study

It was conducted on 30 participants to check the reliability of the questionnaire. Cronbach's alpha coefficient was used to assess internal consistency.The reliability score was 0.89.

Statistical Analysis

Data entry was performed in MS Excel and analysis was conducted using SPSS v.16.0. Descriptive statistics were used to represent the data.The Continuous data were presented as mean± standard deviations, while categorical data were expressed as frequency percentages. Kendall's tau-b correlation test was used to examine association between dietary intake and cognitive performance.

Results

Sociodemographic Characteristics

The study comprised 160 participants (80males, 80 females) from Pune, Maharashtra, and aged 18-25 years with a mean age of 20.66±1.877 years.

Regarding educational status, 112(70%) were graduates, 26(16.2%) were postgraduates, and 22(12.8%) had completed 12th standard.

Socioeconomic classification using the kuppuswamy scale revealed diverse socioeconomic representation, with the majority belonging to the upper-middle and middle class population.

Regarding Dietary preference was non-vegetarian in 82(51.2%), vegetarian in 61(38.1%), eggetarian in 10(6.2%), and vegan in 6(3.8%). Most participants (53.8%) consumed three meals per day, while 46.2% reported skipping meals.

Dietary Habits and Food Frequency

Among nuts, Groundnuts (29.4%), were the most commonly consumed nut daily, followed by almonds (23.1%). And specialized seeds like gardencress, gingelly seeds and safflower seeds were "never"consumed by approximately 60% of the participants.Tomatoes were consumed daily by 35.6%of participants.High frequency vegetables included ladies finger and peas (46.2%each) consumed 3-4 times weekly. By contrast, leafy greens such as parsley, lettuce, and mustard leaves were rarely or never consumed by over 65%of the participants.

Nutritional Adequacy (24-Hour Dietary Recall)

The 24-hour dietary recall indicates participants had an overall energy deficit (~106 kcal in males and ~146 kcal in females) despite consuming excessive carbohydrates (+148.07 g in males and +120.82 g in females) and fats (+47.45 g in males and+32.83 g in females), often two to three times the RDA.Protein intake showed a slight surplus in males (+10.27 g) and a marginal deficit in females (-0.94 g).

Table 1: 24-Hour Dietary Recall -Macronutrient Intake vs.RDA

Nutrient	Male Intake (Mean±SD)	Female Intake (Mean±SD)	RDA (Male)	RDA(Female)
Energy (Kcal)	2004.09±699.82	1513.90±331.35	2110	1660
Carbohydrate (g)	278.07±74.00	250.82±49.44	100-130	100-130
Protein (g)	64.27±33.71	45.06±13.07	54	46
Fat(g)	72.45±26.91	52.83±15.82	25	20

RDA Source: ICMR-NIN, 2024

Cognitive Assessment

Cognitive status was evaluated using MoCA (scores 26-30= Normal Cognitive Function; 18-25= Mild Cognitive Impairment).

Figure 1 shows Out of 160 participants, 114(71.2%) demonstrated normal cognitive function while 46 (28.8%) were classified with mild cognitive impairment (MCI).

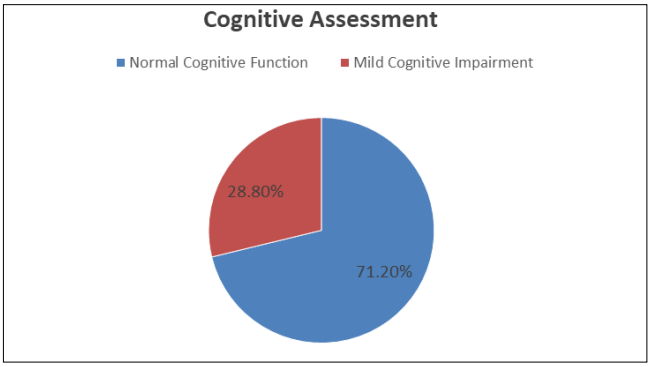

Fig 1: Cognitive Assessment evaluated using Montreal Cognitive Assessment

Figure 2 represent the Gender wise analysis revealed that a higher proportion of males showed normal cognitive function (76.2%) compared to females (66.2%). Mild cognitive impairment was more prevalent among females (33.8%) than males (23.8%). However, the association between gender and cognitive performance (p = 0.164) was not statistically significant.

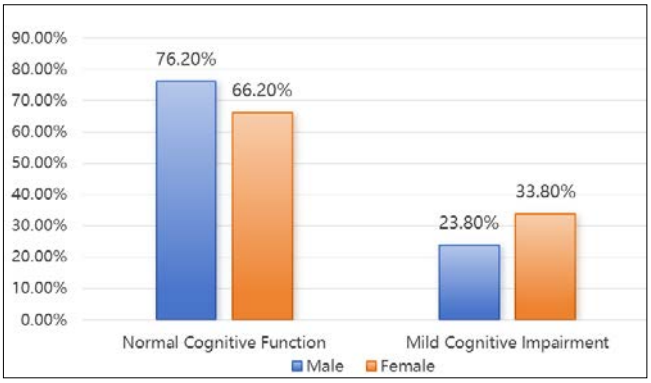

Fig 2: Cognitive Assessment across Gender

Association of Food Frequency with Cognitive Assessment

Table 2 presents Kendall's tau-b correlation test was used to examine the association between food intake frequency and MoCA cognitive scores. A positive tau-b value indicates higher intake associated with better cognitive performance; statistical significance at p<0.05.

Table 2: Significant Association between Food Frequency and Cognitive Assessment (MoCA score)

Food Items	Tau-b Value	P- value
Almonds	0.160	0.025*
Cashew nuts	0.063	0.378
Pistachios	0.053	0.461
Walnuts	0.114	0.115
Cabbage	0.248	0.001**
Cluster beans	0.168	0.020*
Fenugreek leaves	0.152	0.036*
Carrot	0.170	0.018**
Potato	0.179	0.014**
Radish	0.146	0.041*
Lotus Root	-0.030	0.690
Sweet corn	-0.122	0.091

*p<0.05; **p<0.01

Nuts and Seeds: Among nuts, almond consumption shows a significant positive association with cognitive performance (p = 0.025). While other nuts like Cashews (p = 0.378), pistachios (p =0.461), and walnuts (p =0.115) showed positive but non-significant trends.

Most oilseeds like safflower seeds, sunflower seeds, and gardencress and gingelly seeds show non-significant associations.

Vegetables: cabbage demonstrated the strongest significant positive correlation (p =0.001), followed by cluster beans (p = 0.020) and fenugreek leaves (p = 0.036). Root Tuber includes carrot (p = 0.018) potato (p = 0.014) and radish (p = 0.041) also showed positive significance. The Lotus root and sweet corn exhibited negative but non significant association with cognitive function.

Association of Socioeconomic status with Cognitive Assessment

No significant association was found between socioeconomic status and cognitive performance (p =0.995), indicating that socioeconomic background did not significantly influence cognitive outcomes in this study population.

Discussion

This study explored the association between dietary intake of nuts, oilseeds, and vegetables and cognitive performance among young adults in Pune. The findings revealed 28.8% of participants aged 18-25 years met MoCA criteria for mild cognitive impairment, which suggest that inadequate dietary patterns may already be affecting the brain functions during early adulthood.

The significant positive association found for almonds (p =0.025) is consistent with existing studies. Almonds are rich in vitamin E which is powerful antioxidant that protects neuronal cells and prevent oxidative damage as well as riboflavin and L-carnitine these compounds associated with improve neuronal activity and memory performance [8]. also positive but non significant trends observed for

walnuts,cashews and pistachioes. While the walnuts rich in alpha-linolenic acid (ALA), have been consistently linked to improved memory in previous research [9].

The strong positive association between cabbage (p =0.001) and cognitive performance is supported by evidence that red cabbage contains anthocyanins is attenuated age related cognitive dysfunction by reducing neuroinflammation and modulating the gut brain axis [10]. Similarly, fenugreekshows significant association demonstrating that its flavonoid and saponins components exhibit anti inflammatory and anticholinesterase properties that may slow Alzheimer's pathogenesis [11]. Cluster beans are rich in folate and fibre may be mediated through improvement in vascular function and homocysteine metabolism, both are linked to cognitive health [12].

The absence of a significant association between social economic status and cognitive performance (p =0.995) may reflect the educational profile of the participants and narrow income distribution within the sample. However, socioeconomic status did significantly influence the consumption of almonds, cashew, pistachios, and walnuts indicating economical accessibility may be an indirect determinant of cognitive health.

Conclusion

The present study demonstrates a positive association between these dietary patterns and cognitive function among young adults aged 18-25 years in Pune. The consumption of almonds, cabbage, cluster beans, fenugreek leaves, carrot, potato, and radish show positive statistical significance with cognitive performance measured by MoCA. While cashews, pista shoes, and walnuts show positive but non significant trends. Also Lotus root and sweet corn showed negative but non significant association overall these findings suggest specific nutrient reach plant based foods may contribute to better cognitive health in young adults. Dietary intervention targeting early adulthood is a critical period for establishing lifelong eating behaviour and can potentially help to reduce the future burden of cognitive decline and neurodegenerative disorders.And also future research is recommended to confirm these associations and establish relationships.

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