ORIGINAL RESEARCH

From Kitchen to Clinic: Exploring the Pharmacotherapeutic Potential of Common Indian Spices in Age-Related Neurological Disorders

[1]Sanjay Kumar, [2]Ishan, [3]Monika Jha, [4]Sarmistha Paul, [5]Shambhavi Kumari, [6]Nikhil Kumar, [7]Simran Sinha

[1]Associate Professor & HOD, Department of Neurology, Patna Medical College & Hospital, Patna, Bihar, India
[2]Post Graduate Trainee, Department of Neurology, Paramhans Institute of Neurology, Patna, Bihar, India
[3]Senior Resident, [4,6]PG-3, Department of General Medicine, Patna Medical College & Hospital, Patna, Bihar, India
[5,7]PG-2, Department of Ophthalmology, Patna Medical College & Hospital, Patna, Bihar, India

Corresponding Author
Sanjay Kumar
Associate Professor & HOD, Department of Neurology, Patna Medical College & Hospital, Patna, Bihar, India

Received date: 22 March, 2024 Acceptance date: 24 April, 2024

ABSTRACT

Background: Age-related neurological disorders, including Alzheimer's disease, Parkinson's disease, and dementia, are increasing global health challenges. Existing pharmacological treatments provide symptomatic relief but often fail to address the underlying pathophysiology. Indian spices, traditionally used in culinary and medicinal practices, contain bioactive compounds with potential neuroprotective properties.**Aim:** To evaluate the pharmacotherapeutic potential of common Indian spices in mitigating age-related neurological disorders and their role as adjunctive therapies.**Methods:** This retrospective observational study was conducted at Patna Medical College over one year, involving 200 participants with age-related neurological disorders. Participants were categorized into three groups (low, medium, high spice consumption) based on dietary records. Neurological improvement was assessed using clinical notes and cognitive scores (MMSE). Statistical analysis was performed using SPSS version 23.0 to identify correlations between spice consumption and outcomes.**Results:** Participants in the high spice consumption group demonstrated significant neurological improvement (83.3%) compared to medium (56.3%) and low (33.3%) consumption groups ($p < 0.001$). Turmeric, containing curcumin, showed the strongest neuroprotective effects, followed by ginger, cinnamon, and garlic. Cognitive function also improved significantly in the high spice consumption group, with a mean MMSE score increase of +3.5 points ($p < 0.001$).**Conclusion:** The study highlights the potential of spices like turmeric, ginger, cinnamon, and garlic in reducing neuroinflammation, oxidative stress, and cognitive decline in age-related neurological disorders. High spice consumption was associated with significant improvement in clinical and cognitive outcomes.**Recommendations:** Further prospective studies and clinical trials are needed to explore the mechanisms underlying these findings and to standardize spice-based interventions. Integrating such dietary strategies with existing treatments may provide an affordable and culturally acceptable approach to managing neurological disorders.

Keywords: Age-related neurological disorders, Indian spices, neuroprotection, curcumin, cognitive improvement

INTRODUCTION

Age-related neurological disorders, such as Alzheimer's disease, Parkinson's disease, and dementia, are growing public health concerns globally, particularly in aging populations. These disorders significantly impair cognitive, motor, and emotional functioning, leading to reduced quality of life and increased healthcare costs. Current pharmacological treatments often provide symptomatic relief without addressing underlying pathophysiological mechanisms, prompting the need for alternative and adjunct therapies. Among these, dietary interventions, particularly the use of bioactive compounds in traditional spices, have gained attention for their potential neuroprotective properties.

Indian spices, integral to both culinary practices and Ayurvedic medicine, are rich sources of bioactive compounds with anti-inflammatory, antioxidant, and neuroprotective properties. Curcumin, the active compound in turmeric (*Curcuma longa*), has been

extensively studied for its ability to inhibit amyloid-beta aggregation and reduce neuroinflammation in Alzheimer's disease models. Its capacity to cross the blood-brain barrier makes it a promising candidate for neurotherapeutic applications [1]. Additionally, piperine, a component of black pepper (*Piper nigrum*), enhances curcumin's bioavailability, increasing its therapeutic efficacy. Piperine has also shown cognitive-enhancing effects by modulating neurotransmitter pathways [2].

Ginger (*Zingiberofficinale*), known for its anti-inflammatory and antioxidant properties, has demonstrated potential in mitigating neuroinflammation and oxidative stress, both critical factors in neurodegeneration. Studies have shown that ginger extracts improve memory and learning in animal models, indicating its promise in preventing cognitive decline [3]. Similarly, cinnamon (*Cinnamomumverum*), containing cinnamaldehyde and epicatechin, has been found to inhibit tau protein aggregation, a key pathological feature of Alzheimer's disease. Its antioxidant properties further contribute to neuronal health by reducing oxidative stress [4].Garlic (*Allium sativum*), widely used in traditional medicine, contains sulfur compounds such as allicin that exhibit neuroprotective effects. Research suggests that garlic supplementation improves cognitive function and reduces the risk of neurodegenerative disorders by modulating inflammatory pathways [5].Emerging evidence underscores the role of these spices in promoting brain health through their multifaceted pharmacological properties. Their inclusion in daily diets presents an affordable and culturally acceptable strategy to combat the growing burden of neurological disorders. To evaluate the pharmacotherapeutic potential of common Indian spices in mitigating age-related neurological disorders and their role as adjunctive therapies.

METHODOLOGY

Study Design

This is a retrospective observational study aimed at exploring the pharmacotherapeutic potential of common Indian spices in age-related neurological disorders. The study analyzes clinical data of patients treated for neurological conditions, focusing on their dietary habits and potential correlations with the use of spices.

Study Setting

The study was conducted at Patna Medical College, a tertiary care hospital known for its multidisciplinary clinical services. The study involved data analysis from patient records and dietary surveys documented in the hospital database.

Participants

The study included a total of 200 participants whose medical records and dietary data met the inclusion criteria. Participants were selected from a pool of patients treated for age-related neurological disorders, ensuring a representative sample.

Inclusion Criteria

- Patients aged 50 years and above.
- Diagnosed with age-related neurological disorders such as dementia, Parkinson's disease, or Alzheimer's disease.
- Patients with detailed dietary history documented in their medical records.
- Records available during the study period (1 year).

Exclusion Criteria

- Patients with incomplete dietary or medical records.
- Presence of comorbidities that might confound the results, such as severe cardiovascular diseases or metabolic disorders.
- Patients on investigational or experimental therapies for neurological conditions.
- Those unwilling to allow their data to be used in the study.

Bias

To minimize bias, all data were anonymized before analysis, and a double-blind protocol was used during data assessment. Confounding factors such as socioeconomic status, other dietary habits, and pre-existing conditions were adjusted statistically.

Data Collection

Data were collected retrospectively from the hospital's electronic medical record (EMR) system. The records included patient demographics, neurological diagnoses, and detailed dietary habits emphasizing the consumption of spices like turmeric, ginger, cinnamon, and garlic.

Procedure

The dietary records were analyzed to identify patterns in the consumption of specific spices. Neurological outcomes and progression were assessed using clinical notes and standardized neurological assessment scores. Patients were stratified into groups based on their reported spice consumption for comparative analysis.

Statistical Analysis

Data were analyzed using SPSS version 23.0. Descriptive statistics were used to summarize participant demographics and spice consumption patterns. Inferential statistics, including chi-square tests and logistic regression, were employed to identify correlations between spice consumption and neurological outcomes. A p-value < 0.05 was considered statistically significant.

RESULTS

A total of 200 participants were included in the study. The demographic characteristics are summarized in **Table 1**.

Table 1: Demographic Characteristics of Participants

Characteristic	Total (N=200)	Low Spice Group (n=60)	Medium Spice Group (n=80)	High Spice Group (n=60)
Mean Age (years)	68.2 ± 7.5	69.1 ± 6.8	67.8 ± 7.2	67.5 ± 8.0
Male (%)	58%	60%	57%	55%
Female (%)	42%	40%	43%	45%
Mean Disease Duration (years)	5.2 ± 2.1	5.5 ± 2.3	5.1 ± 2.0	5.0 ± 2.1

Participants were predominantly male (58%), with a mean age of 68.2 years. There were no significant differences in age, gender distribution, or disease duration across the three spice consumption groups.

Spice Consumption and Neurological Improvement

The correlation between spice consumption and improvement in neurological symptoms is shown in **Table 2**.

Table 2: Spice Consumption and Neurological Symptom Improvement

Spice Consumption Group	Participants (n)	Improved Symptoms (n)	Improvement (%)	No Improvement (n)	No Improvement (%)
Low	60	20	33.3%	40	66.7%
Medium	80	45	56.3%	35	43.7%
High	60	50	83.3%	10	16.7%

Participants with high spice consumption showed a significantly greater improvement in neurological symptoms (83.3%) compared to the medium (56.3%) and low (33.3%) consumption groups. Statistical analysis (Chi-square test) confirmed a significant association between spice consumption and symptom improvement ($p < 0.001$).

Association of Specific Spices with Symptom Improvement

An analysis of individual spices is presented in **Table 3**.

Table 3: Specific Spices and Neurological Improvement

Spice	Users (%)	Improvement (%)	Statistical Significance (p-value)
Turmeric	72%	78%	< 0.001
Ginger	65%	65%	0.002
Cinnamon	50%	60%	0.005
Garlic	55%	62%	0.007

Turmeric had the strongest association with neurological improvement (78%, $p < 0.001$), followed by ginger (65%), cinnamon (60%), and garlic (62%). The results indicate that spices with known anti-inflammatory properties may contribute to symptom improvement.

Comparison of Cognitive Scores Before and After Treatment

Cognitive function, as assessed by the Mini-Mental State Examination (MMSE), was compared across groups before and after treatment (Table 4).

Table 4: Change in MMSE Scores by Spice Consumption

Group	Baseline MMSE (Mean ± SD)	Post-Treatment MMSE (Mean ± SD)	Mean Difference	p-value
Low Spice Consumption	20.5 ± 3.2	21.0 ± 3.4	+0.5	0.08
Medium Spice Consumption	21.2 ± 3.0	23.1 ± 3.5	+1.9	0.02
High Spice Consumption	21.5 ± 3.1	25.0 ± 3.7	+3.5	< 0.001

Participants in the high spice consumption group showed the most significant improvement in MMSE scores (+3.5, $p < 0.001$), followed by the medium consumption group (+1.9, $p = 0.02$). No significant improvement was observed in the low consumption group ($p = 0.08$).

SUMMARY OF RESULTS

1. High spice consumption was associated with the greatest improvement in neurological symptoms and cognitive scores.
2. Turmeric emerged as the most effective spice, with significant neurological benefits.
3. These findings suggest that spices with anti-inflammatory and neuroprotective properties may positively impact age-related neurological disorders.

DISCUSSION

The study revealed a significant association between the consumption of common Indian spices and the improvement of neurological symptoms in patients with age-related neurological disorders. Participants were categorized into three groups based on their spice consumption levels: low, medium, and high. A total of 200 participants were analyzed, with demographic characteristics showing no significant differences in age, gender distribution, or disease duration across the groups. This homogeneity strengthens the reliability of the findings.

Participants in the **high spice consumption group** exhibited the greatest improvement in neurological symptoms, with 83.3% showing positive outcomes, compared to 56.3% in the medium group and 33.3% in the low group. These results were statistically significant ($p < 0.001$), indicating a robust relationship between spice consumption and neurological improvement.

Turmeric, known for its anti-inflammatory and neuroprotective properties, emerged as the most beneficial spice, with 78% of its users experiencing symptom improvement ($p < 0.001$). Other spices, such as ginger, cinnamon, and garlic, also demonstrated significant positive effects, with improvement rates ranging from 60% to 65% ($p < 0.01$). This highlights the pharmacotherapeutic potential of these spices in managing age-related neurological disorders.

Cognitive function, assessed using the Mini-Mental State Examination (MMSE), also showed significant improvements among high spice consumers. The mean MMSE score increased by +3.5 points post-treatment in this group, compared to +1.9 in the medium group and +0.5 in the low group. These findings suggest that higher spice consumption is associated with better cognitive outcomes, with statistical significance observed for medium and high groups ($p < 0.05$).

Indian spices have demonstrated significant pharmacotherapeutic potential in the treatment of age-related neurological disorders (ANDs). A 2022 review by Norouzkhani et al. summarized the neuroprotective effects of spices like cumin, black cumin, black pepper, curry leaves, fenugreek, fennel, cardamom, cloves, and coriander. These spices exhibit anti-inflammatory and antioxidant properties that protect against neurodegenerative diseases such as Alzheimer's disease (AD) and Parkinson's disease (PD), neuroinflammation, and oxidative stress [6]. Curcumin, the bioactive compound in turmeric, has been extensively studied for its role in AD. It prevents amyloid-beta (Aβ) aggregation, crosses the blood-brain barrier, and improves cognitive functions in animal models. Clinical trials are ongoing to address limitations in its bioavailability [7]. Garlic, another commonly used spice, has been shown to exhibit neuroprotective effects due to its potent antioxidant and anti-inflammatory properties. It mitigates the pathological hallmarks of ANDs, including oxidative stress and protein misfolding, and has potential applications in AD and PD [8]. Black pepper and its bioactive compound, piperine, have been highlighted for their neuroprotective properties. Piperine modulates cell survival signaling pathways, reduces oxidative stress, and has been integrated into nanodelivery systems to enhance bioavailability in AND treatments [9]. Pomegranate, rich in polyphenols, has shown efficacy in alleviating oxidative stress and neuroinflammation associated with ANDs. It also reduces the accumulation of misfolded proteins in the brain, contributing to neuroprotection [10].

CONCLUSION

In conclusion, the study underscores the potential benefits of incorporating spices such as turmeric, ginger, cinnamon, and garlic into the diet for patients with age-related neurological disorders. The findings advocate for further research to explore these natural compounds' underlying mechanisms and therapeutic applications. This study highlights the possibility of leveraging traditional dietary practices for clinical benefits in managing neurodegenerative conditions.

REFERENCES

1. Yadav D, Kumar R, Arora R. Curcumin as a neuroprotective agent: A review on clinical efficacy. *J Ethnopharmacol*. 2020;247:112236.
2. Ahmad R, Tripathi A, Tripathi P. Piperine and its therapeutic potential in neurodegenerative disorders. *Front Aging Neurosci*. 2021;13:647421.
3. Zeng Y, Yang J, Du J, et al. Neuroprotective effects of ginger against neurodegenerative diseases. *Food Funct*. 2019;10(5):3040-3054.
4. Barkatullah S, Khan I, Ullah R. Cinnamon's role in combating Alzheimer's disease: A systematic review. *Phytother Res*. 2021;35(5):2374-2385.
5. Ried K, Fakler P. Garlic in dementia prevention: A review of the evidence.*NutrNeurosci*. 2019;22(7):439-446.
6. Norouzkhani N, Karimi A, Badami N, et al. From kitchen to clinic: Pharmacotherapeutic potential of common spices in Indian cooking in age-related neurological disorders. *Front Pharmacol*. 2022;13:960037.
7. Reddy P, Mańczak M, Yin X, et al. Protective effects of Indian spice curcumin against amyloid-β in Alzheimer's disease. *J Alzheimers Dis*. 2018;61(3):843–866.
8. Ahangar-Sirous R, Poudineh M, Ansari A, et al. Pharmacotherapeutic potential of garlic in age-related neurological disorders. *CNS NeurolDisord Drug Targets*. 2021;20(6):489–502.
9. Balakrishnan R, Azam S, Kim IS, et al. Neuroprotective effects of black pepper and its bioactive compounds in age-related neurological disorders. *Aging Dis*. 2022;13(10):1371–1392.
10. Kazemabad MJE, Toni SA, Tizro N, et al. Pharmacotherapeutic potential of pomegranate in age-related neurological disorders. *Front Aging Neurosci*. 2022;14:955735.