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Research Article

Efficacy of *Kushmand Avaleha* in slow learners as a memory enhancer for improving IQ: A randomized placebo-controlled clinical study

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Abstract

Background: Slow learners are students with an intellectual quotient level between 70 to 81 range and are characterized by difficulty in learning, writing, grasping, and memory. *Medhya Rasayana* is a polyherbal formulation in Ayurveda called a brain tonic that helps enhance brain functions and cognitive ability. *Benincasa hispida is* one of the ingredients used in the *Medhya Rasayana. Kushmanda Avaleha*, which has the same effect as the *Medhya Rasayana* in enhancing memory, is made of *B. hispid*. The present study aims to evaluate the efficacy of *Kushmanda Avaleha*'s in improving the IQ of students categorized as slow learners. Methods: Students were divided into two groups (groups A and B). Group A (trial group) students were given *Kushmanda Avaleha*, and Group B students (control group) were given a placebo. The students were selected based on their last year's academic performance. Results: The results revealed that group A students administered *Kushmanda Avaleha* showed improved IQ and academic performance after treatment. A higher statistical significance was observed within Group A before and after treatment (P<0.001). However, group B students provided with a placebo did not show improvement in their IQ or academic performance. The significance between groups A and B was also observed after treatment. Conclusion: The study's findings revealed that *Kushmanda Avaleha* can increase students' IQ levels by enhancing their memory power, thus suggesting that it can be used as a therapeutic agent for enhancing cognitive ability.

Keywords: Ayurveda, *Benincasa hispida,* Cognitive ability, *Kushmanda Avaleha*, *Medhya Rasayana*, Memory

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Introduction

In the Indian medicine system (Ayurveda), various *rasayanas* (*rasa* means juice and *ayana* means path) are used, which are considered to be "rejuvenating therapies" or "tonics" in Ayurvedic medicine to enhance overall health and longevity; the *Medhya Rasayana* (brain or nervine tonic or memory rejuvenators) is one of them (1). It is a polyherbal Ayurvedic formulation that contains *Withania somnifera Dunal*. (Ashwagandha), *Embelia ribes Burm.* (Vidanga), *Celastrus paniculatus Willd.* (Jyotishmati), *Centella asiatica L.* (Mandukaparni), *Tinospora cordifolia Willd.* (Guduchi), *Acorus calamus L.* (Vacha), *Saussurea lappa Deone.* (Kustha), *Achyranthes aspera L.* (Apamarga), *Benincasa hispida Thunb*. (Kushmanda), *Asparagus racemosus* (*Satavari*), *Bacopa monnieri L.* (Brahmi), *Convolvulus pluricaulis Chois*. (Shankhpushphi), *Glycyrrhiza glabra L.* (Yashtimadhu), *Clitoria ternatea L.* (Sankhini), *Nardostachys jatamamsi* (Jatamamsi), and *Terminalia chebula Retz.* (Haritaki) (2,3), *Medhya Rasayana* effectively improves the intellect, enhances memory, and rejuvenates the brain's functions (4).

Regular intake of such drugs will help to prevent the onset of degenerative changes in the brain prematurely and help in memory enhancement. *Kushmanda is* one of the important memory enhancing herbs mentioned in the ancient *Ayurvedic* literature and *Kushmanda Avaleha is considered as Medhya Rasayana* which can improve intellect, memory (5).

According to the International Classification of Diseases and Diagnostic and Statistical Manual of Mental Disorders (IV), students with an intelligence quotient between 71 and 80 are considered slow learners or achievers. The intellectual functioning of these students is found to be borderline. The students have cognitive difficulty in grasping, learning, writing, reading, and memory. These students are at risk of developing lower self-esteem, anxiety, mood swings, depression, and suicidal ideation and have to be monitored and motivated properly to overcome this condition.

While *Medhya Rasayana* formulations have been traditionally used in Ayurveda to enhance cognitive functions such as memory and intellect, there is limited scientific evidence assessing the

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specific impact of *Kushmanda Avaleha*, a *Medhya Rasayana,* on slow learners or borderline intellectual functioning students (IQ 71–80). Most existing literature focuses on general memory enhancement or adult populations, with insufficient clinical or empirical evaluation in the academic performance and cognitive upliftment of school-going children with borderline IQ. Furthermore, while the role of various herbs in cognitive enhancement is acknowledged, *Kushmanda's* (Benincasa hispida) specific contribution and its standalone or integrated effect in the cognitive development of slow learners remains underexplored in controlled or observational studies. The present study aims to assess *Kushmanda Avaleha*'s *capacity* to improve slow learners' memory and intelligence quotients in academics.

Objectives

- To assess the efficacy and safety of *Kushmanda Avaleha* in slow learners of the age group 10-16years.
- To evaluate the efficacy of *Kushmanda Avaleha* in enhancing the memory of slow learners.
- To assess the difference in the academic achievement of slow learners with respect to their intelligence.

Methodology

Data collection

One hundred eighty students were selected for the present study. It was a placebo-controlled, open-label, simple randomised, unblinded study; here, the participant was unaware of their treatment assignment. The samples were collected from various schools in Mangalore city, Dakshina Kanada district, Karnataka. The students were selected from the following schools: Moulana Azad Model School, Shree Bharati Aided Higher Primary School, D.K.Z.P. Govt. Model Higher Primary School, D.K.Z.P. Govt. Higher Primary School and Amruthlalji High School. The samples were collected using simple random and blind sampling methods. G*Power software was used to calculate the sample size. At a 95% level of confidence and 90% power, with a standard effect size of 0.5. An informed consent form was provided to all the student participants. The students were scrutinized irrespective of their sex, socio-economic status, religion, and caste. A proper ethical clearance certification was obtained before the study. The ethical clearance certification number is YEC-1/2021/062, and the CTRI number is CTRI/2022/10/046675.

Subject recruitment

The inclusion criteria for the present study are i) age group between 10 to16 years, students who secured less than 50% in the final examination in the last two years, ii) consistent under performers in academics, and iii) students with an IQ level between 75-90 range, and parent's willingness to participate.

In exclusion criteria i) students with an IQ level below 75, students with intellectual disability, ii) a previous history of hospitalization due to a head injury, subnormal students, major illnesses, genetic and congenital abnormalities (Down syndrome), psychotic symptoms, iii) being currently under treatment for epilepsy, already taking part in other research studies involving the usage of immunomodulatory drugs, or currently undergoing therapies or treatment for enhancing memory power were excluded.

Subject withdrawal criteria

The students were categorized as slow learners based on their percentage of academic achievement in the last two years. Discontinuity in weekly follow-up (two weeks), students who developed serious side effects, and discontinuity in treatment during the trial run were excluded from the study.

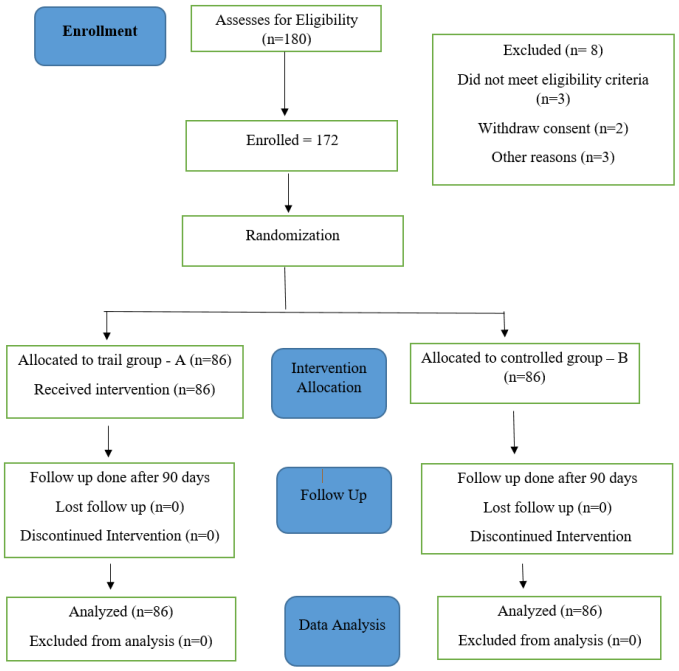
Diagnostic and Assessment Criteria

The drug assessment test was based on the following factors: academic achievement and the IQ test (Malin's Intelligence Scale for Children (MISC), validated in the Indian population) before and after the intervention. The Malin's Intelligence Scale for Indian Children" (MISIC) consists of 11 subset tests (information, vocabulary, object assembly, digit span, general comprehension, block design, mazes, arithmetic, picture completion, coding, and analogies and similarities). These subsets were classified into two groups: performance and verbal.

Grouping and administration methods

About 180 students (10 to 16 years of age) were registered and selected for the study, of whom 8 students were excluded based on withdrawal criteria, and the remaining 172 students were randomly divided into two groups (A and B), each comprising 86 students. The intervention in the present study is 90 days. Each student was provided with codes to maintain the confidentiality of participants. The students in group A (the trial group) were administered a dose of 5gm of *Kushmanda Avaleha* twice daily, in the morning and at night, before food with lukewarm milk. Group B (control group) students were administered 5gm of Placebo (the same formulation of *Kushmanda Avaleha*, but *Kushmanda* is replaced with wheat flour) twice daily, morning and night, before food with lukewarm milk. In the morning, the intervention is given on an empty stomach, and during the night, the intervention is administered 45 minutes before food (Aushadha Sevana Kaala, i.e., the specific times for administering medicine according to Ayurvedic principles). The assessment of students was carried out before and after the intervention. The source of the drug is K.V.G. Ayurveda Pharma and Research Centre, Ambate Adka, Dakshina Kannada, Sullia, Karnataka 574327 (CTRI Registration Details: REF/2022/04/053655, CTRI/2022/10/046675).

Flow chart 1: Participant flow diagram



The following instructions were given to the parents to carry out during the study period: i) Parents are advised to administer the intervention every day at home without fail; ii) Parents were provided with a dairy-like sheet for three months (90 days) and asked to tick them daily to keep record; iii) Parents were advised to inform the principal investigator in case of adverse or adverse effects are seen in students; and iv) In case of any other illness, students were advised to take Ayurvedic medicine during the study period.

Statistical Analysis

The statistical analysis of the data obtained from the present study is performed using IBM SPSS Statistics (Version 21). The significance level was analyzed using a Mann-Whitney A U test, and the significance level was set at *P<0.001*.

Results

A total of 172 student participants were divided into two groups (A-trial group and B-control group). Group A was administered *Kushmanda Avaleha*, and Group B was given a placebo. The difference in students' academic achievement and IQ levels in the two groups before and after the treatment was measured using performance and verbal tests. The results showed significant improvement in the students in group A, who received *Kushmanda Avaleha*, compared to group B students, both in IQ and academic achievement. Mann-Whitney A U test was employed to assess groups A and B. The Wilcoxon signed-rank test was used to analyze the significance within the group.

In group A, IQ score (verbal and performance test scores) and academic achievement were found to be increased after treatment. The mean of the verbal test score was elevated in group A after treatment by 1.05 times. The mean of the performance test score was increased in group A after treatment by 1.05 folds. The mean IQ score increased in group A after treatment by 1.05 times. The mean academic achievement was elevated in group A after treatment by 1.09 times. A high significance was observed within group A with a *P* value of *P<0.001* in IQ score and academic achievement before and after treatment with *Kushmanda Avaleha* (**Table 1**).

Table 1: Results of the IQ score and academic achievement of group A

Group A					
	Mean	**Median**	**SD**	**Test statistics**	***P* value**
Verbal test score: BT	77	77.6	3.55	-6.809	<0.001[a]
Verbal test score: AT	81.1	81.1	4.11		
Performance test score: BT	80.6	80.2	4.36	-7.21	<0.001[a]
Performance test score: AT	85.2	84.4	4.8		
IQ score: BT	78.8	79	2.48	-7.939	<0.001[a]
IQ score: AT	83.3	83	2.98		
Academic achievement: BT	41.3	42	5.34	-7.551	<0.001[a]
Academic achievement: AT	45.3	46	4.78		

BT: Before treatment; AT: After treatment

Significance levels at P<0.001[a], and non-significant [b]

The results of group B's IQ score (verbal and performance test scores) and academic achievement were found to be almost unchanged after treatment with a placebo. A statistical significance was observed in performance test scores (*P*<0.001) and IQ scores (*P*<0.001) before and after treatment. However, academic achievement and verbal test scores were found to be non-significant before and after treatment with a placebo (**Table 2**).

Table 2: Results of IQ score and academic achievement of group B

Group B					
	Mean	**Median**	**SD**	**Test statistics**	***P* value**
Verbal test score: BT	76.8	76.7	1.84	-3.074	0.002[b]
Verbal test score: AT	76.9	76.8	1.81		
Performance test score: BT	77.1	77	2.05	-7.751	<0.001[a]
Performance test score: AT	77.9	77.6	2.01		
IQ score: BT	76.9	76.8	1.64	-7.89	<0.001[a]
IQ score: AT	77.4	77.3	1.6		
Academic achievement: BT	42	42	5.11	-2.032	0.042[b]
Academic achievement: AT	42.2	42	4.92		

BT: Before Treatment; AT: After Treatment

Significance levels at P<0.001[a] and non-significant [b]

Post-treatment results in groups A (*Kushmanda Avaleha*) and B (placebo) showed that a higher mean score was observed in group A than in group B in verbal test scores, performance test scores, IQ tests, and academic achievement. The mean verbal test score in group A was 1.05 folds higher than in group B after treatment. The mean performance test score in group A was 1.09 times higher than in group B after treatment. The mean IQ score in group A was 1.07 times higher than in group B after treatment. The mean academic achievement in group A was 1.07-fold higher than in group B after treatment. A high significance level was observed between groups A and B with a *P* value of *P<0.001* in IQ score and academic achievement after treatment with *Kushmanda Avaleha* and placebo (**Table 3**).

Table 3: Results of post-intervention scores of Group A and Group B

	Group	**Mean**	**Median**	**SD**	**Test statistics**	***P* value**
Verbal test score: AT	A	81.1	81.1	4.11	-8.481	<0.001[a]
	B	76.9	76.8	1.81		
Performance test score: AT	A	85.2	84.4	4.8	-9.857	<0.001[a]
	B	77.9	77.6	2.01		
IQ score: AT	A	83.3	83	2.98	-10.487	<0.001[a]
	B	77.4	77.3	1.6		
Academic achievement : AT	A	45.3	46	4.78	-4.221	<0.001[a]
	B	42.2	42	4.92		

AT: After Treatment

Significance levels at P<0.001[a] and non-significant [b]

Discussion

Students with marginal or slow intellectual capacity with an IQ between 71-80 are termed slow learners who struggle with academic achievements (grasping, writing, and reading) (6). According to Ayurveda, the *Medhya Rasayana* was helpful in ameliorating memory power and brain function presented that pre-treatment with *Medhya Rasayana* effectively restored the cognitive dysfunction caused by doxorubicin in mice (7). In school-going students, the efficacy of *Medhya Rasayana* and yoga practice was compared to observe which improved memory. The study's findings revealed that the *Medhya Rasayana* was quicker in elevating students' memory than yoga practices (8). *Kushmanda Avaleha*, an Ayurvedic formulation made of *B. hispida*, exhibits similar cognitive-enhancing properties as *Medhya Rasayana*, which are traditionally used to improve memory and cognitive function (9). The present study is aimed at evaluating *Kushmanda Avaleha*'s ability to improve the memory and IQ scores of slow learners in terms of academic achievement.

Few members of the Cucurbitaceae family have exhibited the capacity to enhance memory and learning. A study conducted by Joshi *et al.* (2017) revealed that *Momordica charantia* (bitter melon) can potentially reverse the amnesia induced by scopolamine (10). Sepehri *et al.* (2019) demonstrated that a reduction in memory and learning is caused by feeding a high-cholesterol diet to mice, which the administration of M. *charantia* can normalize (11). Kumar and Parle (2014) assessed the cognition-enhancing effect of *Cucumis sativus, and* the results demonstrated that *C. sativa* was significant in elevating the cognitive function of the *ad libitum* mice (12). Pahari *et al.* (2022) stated that the fruit of *B. hispida* can act as a remedy for memory loss and a memory enhancer (13). Bharti et al. (2013) studied the effect of aqueous and methanolic extracts of *B. hispida* (seeds) on mice induced with scopolamine (14). The results showed that the methanolic extract of *B. hispida* effectively restored memory and learning ability in the scopolamine-induced mice. Zaini *et al.* (2011) proposed that *B. hispida* is efficient in memory and cognitive functions. It functions by elevating acetylcholine levels, a key neurotransmitter for memory and learning, linked to enhanced cognitive function and memory recall (15). The herb's strong antioxidants protect brain cells from damage, supporting overall brain health and cognitive functions by reducing oxidative stress [30]. Research indicates that *B. hispida* promotes neurogenesis and enhances synaptic plasticity, processes essential for learning and memory, thereby improving cognitive functions and academic performance (16). *Kushmanda Ghrita (polyherbal Ayurvedic formulation made using ghee or clarified butter as a base) is similar to Kushmanda Avaleha (jam-like preparation) and is also considered a Medhya Rasayana (17). Kushmanda Ghrita was found to have the potential to enhance cognitive function in elderly people (18).* Likewise, the present study also revealed that the *Kushmanda Avaleha* administration has improved the IQ scores and academic achievement of students in the trial group.

The results of the present study demonstrated that significant improvements were observed in verbal test scores, performance test scores, IQ scores, and academic achievement in group A (trial group) students after treatment with *Kushmanda Aveleha*. A higher statistical significance was also observed within group A (P<0.001). However, no significant changes were observed in IQ or academic achievement in group B (the control group) students after treatment with a placebo. The study's outcome revealed that the students who administered *Kushmanda Avaleha* (group A) increased their IQ scores and academic achievement compared to those who received a placebo (group B). The statistical significance was observed in the IQ scores (P<0.001) but not in academic achievement. Comparing the after-treatment results of groups A and B showed strong significance (P<0.001) between them. Based on the existing results, the significant improvements in IQ scores and academic achievement in the trial group, with no corresponding changes in the control group, suggest that the observed effects are likely due to the intervention (*Kushmanda Avaleha*) rather than changes in general health. These findings serve as a validation of traditional Ayurvedic claims regarding *Medhya Rasayana* and, specifically, the cognitive-enhancing properties of Benincasa hispida. The effect appears to be attributable to the formulation itself, rather than external factors such as general health improvements or placebo effects. However, without detailed health data or explicit analysis of general health changes, this conclusion assumes that no other significant health factors influenced the results.

Strengths of the Study

Focused Population Group: Targeting a specific and vulnerable group (students with borderline IQ or slow learners) enhances the relevance and applicability of the findings.

Use of Control (Placebo) Group: The inclusion of a control group receiving a placebo strengthens the study design and helps attribute the effects specifically to *Kushmanda Avaleha*.

Statistical Rigor: Statistical analysis (with P-values < 0.001) supports the reliability and significance of the findings.

Traditional Knowledge Integration: The study draws from Ayurveda and evaluates it using modern scientific parameters, thus bridging traditional knowledge and evidence-based medicine.

Multi-dimensional Assessment: The study doesn't rely solely on IQ scores but also examines verbal and performance test scores and academic achievement, offering a comprehensive view of cognitive improvement.

Limitations of the Study

Short Duration: If the treatment and observation period was short, long-term sustainability of cognitive improvement remains unknown.

Sample Size: The sample size was small; it could limit the generalizability of the findings.

Single Intervention Focus: The study only evaluates *Kushmanda Avaleha*. Other confounding variables, such as diet, home environment, or other educational support, were not controlled.

Scope for Future Research

Longitudinal Studies: Conduct long-term follow-ups to assess the sustainability of cognitive and academic improvements.

Larger and Diverse Sample Sizes: Replicate the study with larger and more diverse populations (age, region, educational background) to confirm the findings.

Comparative Studies: Compare *Kushmanda Avaleha* with other *Medhya Rasayanas,* cognitive enhancers, or educational interventions like yoga, meditation, or special education techniques.

Experimental Studies: Conduct biochemical and neuroimaging studies to understand the **neurophysiological mechanisms** through which *Kushmanda Avaleha* works (e.g., acetylcholine levels, neurogenesis markers, oxidative stress indicators).

Multi-Modal Interventions: Explore combining *Kushmanda Avaleha* with non-pharmacological interventions such as remedial teaching or mindfulness training for synergistic effects.

Conclusion

Medhya Rasayana is a brain tonic, according to Ayurveda, which enhances cognitive functions. *Kushmanda Avaleha* (also known as Ayurvedic jam) has the same effect as the *Medhya Rasayana.* In the present study, students administered *Kushmanda Avaleha* group A, which showed a significant increase in their IQ score and academic performance after treatment. A strong statistical significance was observed within group A before and after treatment. However, no increase in IQ score or academic performance was observed in students administered a placebo. A strong difference was observed between groups A and B after treatment. The present study indicates the importance of the therapeutic use of *Kushmanda Avaleha*. The results suggest that the proper duration and dosage of *Kushmanda Avaleha* can act as a memory enhancer in slow learners concerning their IQ.

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