

## Research Article

### Effect of Yashtimadhu (*Glycyrrhiza Glabra*) on Intelligence and Memory Function in Male Adolescents

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**Abstract:** The study was undertaken with an aim to evaluate the effect of Yashtimadhu (*Glycyrrhiza Glabra*) oral supplementation on the mental intelligence and memory function of the male students. For this purpose tablets were formulated from the crude powder prepared from roots and subjected to dose standardization process. The 1 tablet BID (two times in a day) was found to be suitable without any side effects. With this dose the final study was conducted in 123 male students. Students were divided into two groups, treatment (1 tablet BID) and placebo control (received starch powder) for the period of 60 days. Each group was further subdivided into two, based on low and high intelligence percentage in order to avoid biasness. Evaluation of improvement among these students was judged by using parameters such as NVIT (Non Verbal Intelligence Test) and memory test score before the start of treatment and end of treatment period and scored them accordingly into poor, moderate, good and, very good and expressed in percentage. The overall NVIT results indicate that oral consumption of Yashtimadhu tablets BID improves the intelligence level among the student when compared to students who received placebo treatment. In both classes mild memory improvement with Yashtimadhu treatment was observed as compared to control students. The improvement was observed in NVIT as compared to memory was quite higher. The present study concludes that Yashtimadhu consumption improves the general intelligence rather than STM (short term memory).

**Keywords:** Yashtimadhu, *Glycyrrhiza Glabra*, mental intelligence, memory function, Adolescents

#### INTRODUCTION

Mental impairment is defined as a state of arrested or incomplete development of mind, which includes significant impairment of intelligence and social functions. It is associated with aggressive or seriously irresponsible behavior. Mental disorders have been known from ancient times. The epics of Ramayana and Mahabharata provide many examples of mental disturbances. King Dashratha experienced two episodes of depression. Mahabharata also very clearly depicts the anxiety experienced by Arjuna at the battle field. "Geeta" is a classical example of psychotherapy. In addition to this, ancient Greek and Roman literature also provide many examples of behavior, which could be called mental disorders. Hippocrates the father of modern science described Hysteria.

Ayurveda is an ancient medical science, deals with the diagnosis of disease and its treatment with herbal and plant based medicaments. *Glycyrrhiza Glabra* called yashtimadhu in Sanskrit and mulathi in common parlance, liquorice which means the sweet healer. Liquorice was used as a medicine in many ancient civilizations and even today it continues to be a very popular herb around the globe [1]. It grows wild but is also cultivated in sub-tropical and warm regions in many parts of the world including India. It is the root of the plant which constitutes the drug. Ancient

ayurvedic scholars valued liquorice as a repository of many medicinal properties. It has been described as kaphanissaraka (expectorant), kanthya (good for throat), antimutagenic, anti-oxidant activity and nadibalya (nervine tonic), anticonvulsant [2,3,4]. Liquorice is also an anti-pyretic, an anti-inflammatory and a wound-healer medicine [5]. Pandit Bhavamishra has written that liquorice improves the complexion, relieves problems of the eyes [6], acts as spermatogenic [7], antacid agent and also an effective general tonic as well anticonvulsant.

There are many Medhya drugs such as Shankhapuspi, Bramhi and Ashvagandha vaca on which lot of research carried out to screen their psychoneuropharmacological (Medhya action) effect across the globe while no efforts has been taken so far for evaluation psychoneuropharmacological effect of Yashtimadhu even though it is one of the four major Medhya Rasayana drugs mentioned by Charaka [8]. It is easily available and palatable can be given in any age group. Its specific Medhya effect on different faculties of Medhya has not been screened. Considering the usefulness and demand of research on psychoneuropharmacological drugs the Yashtimadhu was selected for evaluating its specific psychoneuropharmacological activity in terms of effect

on intelligence and memory functions in male adolescents.

**MATERIALS AND METHODS**

**Collection and preparation of Yashtimadhu tablets**

250 gm of Yashtimadhu roots were collected from the local market (Ayurved Agency, Dr. Mahendra Sharma, Pune). The roots were authenticated from botanist of T.A.M.V’s Research Centre, Pune. Collected roots dried first under sun and then in shades and ground to fine powder and tablets (500mg) were made from roots powder by wet granulation method by adding together Yashtimadhu powder (465 mg), sugar powder (15 mg), gum acacia powder (10 mg) and small amount of water. Mixture finally passed through granulators and homogeneous granules obtained finally they dried at 40-60 °C temperature in dryers.

**Clinical study and Study design**

Clinical trial was conducted to reassess and establish the psychoneuropharmacological effect of Yashtimadhu. A single blind controlled clinical trial was designed to screen the psychoneuropharmacological activity in 123 male students of ninth standard at Modern High School, Pune.

**Ethical clearance**

Consent of Modern High School’s administrator, teachers and parents was taken prior to starting of project and Informed consent form (ICF) was taken from parents of each of the 123 students. Only those students who willingly participated and submitted informed consent form were enrolled in the project.

**Dose selection study**

Yashtimadhu may induce nausea and vomiting, in large dosage. Hence, dose variation study was conducted for determination of suitable effective dose in the student. For this purpose, Yashtimadhu tablet was given with milk in the following divided doses as follows.

Group A: 7 student given 1 tablet BID for 7 days.

Group B: 7 student given 2 tablet BID for 7 days.

Group C: 7 student given 2 tablet TID for 7 days.

In this study the group C, the effect was maximum with adverse symptoms like nausea and vomiting observed. The dose with maximum effectiveness without producing nausea was observed in group B (2 tablet BID, 1 gm of Yashtimadhu BID at 8 am and 8 pm with the milk). Thus finally dose of two tablets BID was chosen for final clinical study.

**Criteria of selection and grouping**

For this study all the healthy volunteers were selected. The male students of 9<sup>th</sup> class having same age group (13-14 yrs.) were selected. Students were selected by giving NVIT (Non Verbal Intelligence Test) and Memory Test. 123 students were divided into 2 major groups and subdivided into class A and class D by random sampling method. Students were selected irrespective of caste and religion. Students with physical illness, mental disorders like depression anxiety as well as with retardation were excluded from the project considered as an exclusion criterion also drops out the irregular taking tablets and who absent for NVIT and memory test. The period of treatment was for 6 months for all the groups. Follow up was carried out every fourth night.

Groups	Treatment	Total students	Sub-groups		Period (month)
			Class	No. of students	
I	Yashtimadhu	61	Class A	32	6
			Class D	29	
II	Placebo control (Starch powder tablet)	62	Class A	33	6
			Class D	29	

Class A: represents higher intelligence.

Class D: represents relatively lower intelligence.

**Psychometric analysis:**

Memory as well as physical parameter was intellect prepared. The graduation was given as per guidelines given by NIMHANS, Bangalore mentioned in the proforma for mental status examination. The improvement was assessed as per improvement in gradations factors. Psychological assessment was done before and after drug administration with the help of team of psychologist (Talent search group). Battery of psychological tests were applied to measure the enhancement in intellectual skills after drug administration for 6 months. Two tests were performed which includes: NVIT and Memory tests.

**1. NVIT (Non Verbal Intelligence Test):** This test is culture fair test which removes cultural, socio economic and racial basis. Therefore this can be applied in any part of world and in the schools of any medium, like English, Marathi, Hindi, Urdu, Gujarathi, etc.

**2. Memory tests:** A battery of intelligence tests based on Guilford’s structure of intellect model prepared by the Pradnyamanas Kasotimala Shanshodhika, Pune (Institute of Research in Intellect and mind) was used for memory testing. All these tests measure short term memory (STM) was measured for factors for verbal and

numerical. Verbal test consist of parameters such as non relational letters (visual memory), rhyming words, relation between the words and comprehension through transformation. While, numerical test was performed using only numbers 4 to 9 digits and combination of alphabet and, numbers.

The gradation was given as per guidelines given by NIMHANS Bangalore. NVIT and memory test score in both groups were assessed as follows.

1. No Improvement
2. Improvement (0-25 % in the score).
3. Mild Improvement (25-50% in the ease).
4. Moderate Improvement (50-70 % in the score)
5. Very Good Improvement (above 75% in the score)

**Statistical analysis:**

The data was further analyzed to know statistical significance in study group and placebo

controlled group. Students ‘t’ test for unpaired data and for paired data was applied to compare the treatment effect with placebo drug.

**RESULTS:**

The NVIT and memory test was performed before start of treatment independent of groups I and II. Result of this before treatment was presented in Table 1 and Table 2, in the pooled form as class A and class D. The NVIT score of class A was very good (81.53%) than that of class D (50%), whereas, percent of mild to moderate NVIT score was more in class D (13.79% & 17.24%, respectively). The poor memory score was not observed in the class A but it was observed in class D (25.86%). Moreover, percentage of very good memory score was observed in class A (30.76%) while that of class D was very low (6.89%).

**Table 1. Percentage of NVIT score before start of Yashtimadhu and Placebo treatment in students.**

Score	Class A		Class D	
	Students	%	Students	%
Poor (0-25 in the score)	5	7.6%	29	50%
Mild (25-50 in the score)	2	3.07%	8	13.79
Moderate (50-75 in the score)	5	7.6%	10	17.24%
Very good (above 75 in the score)	53	81.53%	11	18.96%

**Table 2. Percentage of memory test score before start of Yashtimadhu and Placebo treatment in students.**

Score	Class A		Class D	
	Students	%	Score	Students
Poor (0-25 in the score)	0	0	15	25.86
Mild (25-50 in the score)	6	9.23%	17	29.31
Moderate (50-75 in the score)	39	60%	20	34.48
Very good (above 75 in the score)	20	30.76%	4	6.89

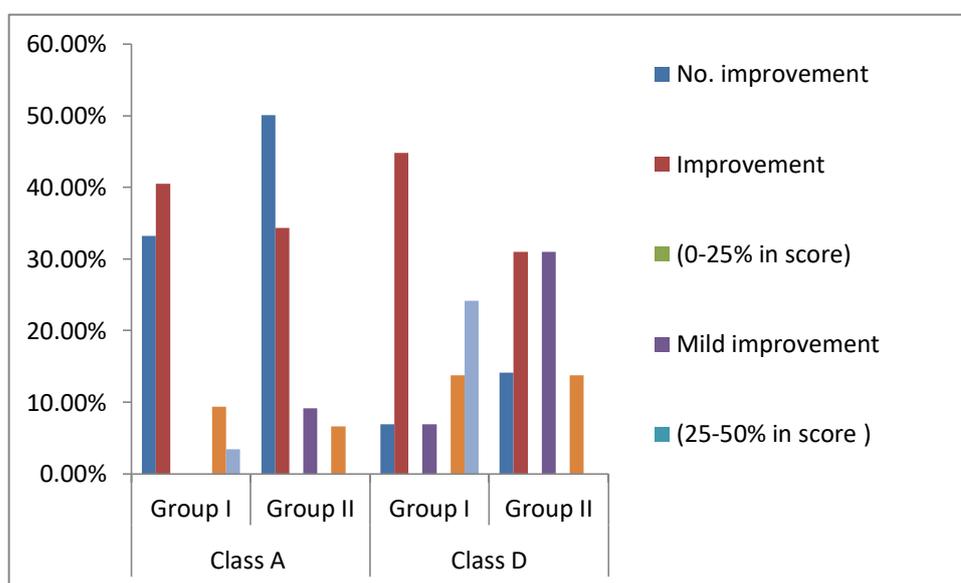
**Effect of Yashtimadhu on NVIT**

According to NVIT score (Table 3 and Figure 1) very good improvement was observed with the treatment of Yashtimadhu in the students of class D (24.13%) and class A 3.44% when compared respective placebo receiving students. Moderate improvement 13.79% was observed in students of class D and 9.37% of students of class A. In this case no much difference was observed in treatment and control was noticed. Mild improvement was observed in 6.89% of class D students and 0% in class A. However percentage of

mild improvement in control group was observed more 31.03% in class D and 9.15% in class A. Majority of students showed improvement in NVIT score (44.82%) in class D where as 40.48% in class A as compared to placebo control group showed only 31.03% and 34.37% improvement in class D and class A student, respectively. Percentage of non improvement was quite less in study group of class D (6.89%) and class A (33.30%) in study group, while, 50.12% in placebo control group.

**Table 3. Percentage of NVIT score after Yashtimadhu and Placebo treatment in the student in class A & D.**

	Class A		Class D	
	Group I	Group II	Group I	Group II
No. improvement	33.20%	50.12%	6.89%	14.13%
Improvement (0-25% in score)	40.48%	34.37%	44.82%	31.03%
Mild improvement (25-50% in score )	-	9.15%	6.89%	31.03%
Moderate improvement (50-75% in score)	9.37%	6.66%	13.79%	13.79%
Very good improvement (above 75% in the score)	3.44%	-	24.13%	-



**Figure 1. Percentage of NVIT score after Yashtimadhu and Placebo treatment in the student in class A & D.**

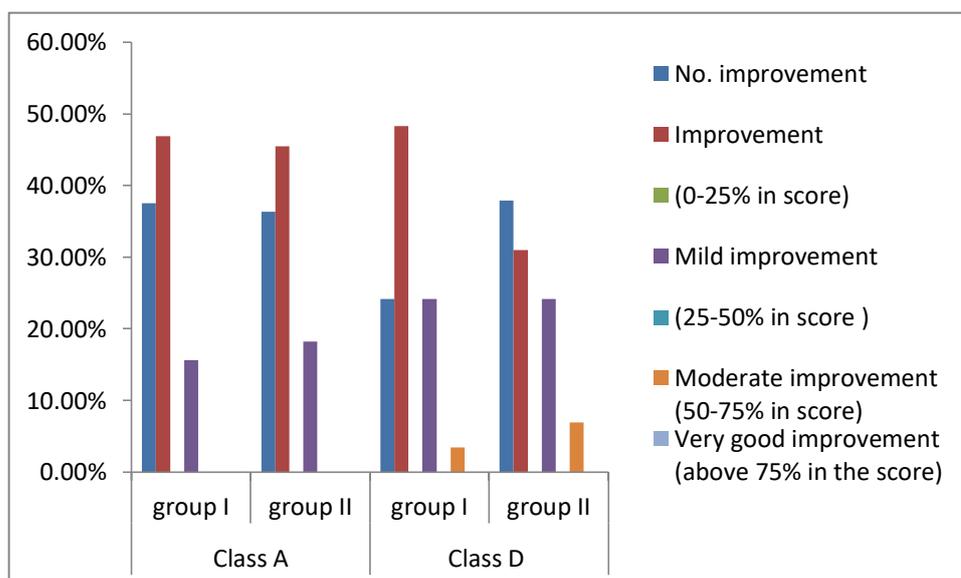
According to NVIT score very good improvement was observed in the students in class D and class A while nobody from placebo control group was in this category. However the improvement was more in class D. This indicates that Yashtimadhu has enhanced the intellectual skills in students with relatively lower intellectual score. Class A student were already of higher intelligence in which even though the Yashtimadhu was effective, but difference between before treatment and after treatment score was not that much remarkable. The overall NVIT result indicates that Yashtimadhu tablet improves the intelligence as compared to placebo control.

#### Effect of Yashtimadhu on Memory Test

There was no remarkable difference in memory score (Table 4 and Figure 2) in both the classes in comparison to control ( $P < 0.1$ ). Study group shows 48.27% improvement in class D and 46.87% in class A. percentage of mind improvement is 24.13% in class D and 15.62% in class A. In both classes marked improvement was observed in NVIT as compared to memory. This indicates that Yashtimadhu improved general intelligence rather than STM (short term memory).

**Table 4. Percentage of memory test score after Yashtimadhu and Placebo treatment in the student in class A & D.**

	Class A		Class D	
	Group I	Group II	Group I	Group II
No. improvement	37.51%	36.36%	24.13%	37.93%
Improvement (0-25% in score)	46.87%	45.45%	48.27%	31.03%
Mild improvement (25-50% in score )	15.62%	18.18%	24.13%	24.13%
Moderate improvement (50-75% in score)	-	-	3.44%	6.89%
Very good improvement (above 75% in the score)	-	-	-	-



**Figure 2. Percentage of memory test score after Yashtimadhu and Placebo treatment in the student in class A & D.**

**DISCUSSIONS:**

Memory is the ability of an individual to record sensory stimuli, information and etc., retain them over a short or long period of time and recall the same whenever needed in due course of time [9]. While, learning is the process of acquiring knowledge about the world and memory could be considered as the retention of the acquired knowledge, which can be retrieved as and when, required [10]. In certain diseases related to the progressive neurodegenerative disorder such Alzheimer’s and many others associated with loss of neurons in distinct brain regions. It decreased intellectual functioning that interferes with normal life functions and is usually used to describe people who have two or more major life functions impaired or lost such as memory, language, perception, judgment and have problem solving abilities reduced or lost. Social and environmental stressful conditions are often associated with memory dysfunction resulted into loss of memory and cognitive functions which may lead to threats of such a diseases.

Nootropics also referred to as smart drugs, memory enhancers, neuro-enhancers, cognitive enhancers, and intelligence enhancers, are drugs, supplements, nutraceuticals, and functional foods that improve mental functions such as cognition, memory, intelligence, motivation, attention, and concentration [11]. Medicinal plants have therapeutic value because of their presence of multi bioactive constituents which responsible for the physiological and pharmacological activity [12]. Very few herbal drugs which have effect on learning and memory functions are available with valid scientific data especially as a monotherapy is concern. Traditionally herbal drugs have been used to enhance cognitive functions and to alleviate other functions associate with the memory dysfunctions. An ayurvedic preparation called Abana contains various herbal ingredients among which the one of the ingredient is *Yashtimadhu*. Similarly, studies related to improvement of memory with *Yashtimadhu* use have been reported. The glabridin from *Yashtimadhu* oral

supplementation remarkably reduced the brain cholinesterase activity. It appears to be a promising candidate for memory improvement [13]. Additionally, aqueous extract (*Yashtimadhu*), administered systemically has spatial effect on memory retention and memory retention enhancement [14]. It helps in improving memory and can be explore the potential of this plant in the management of impaired learning, dementia, Alzheimer's disease and other neurodegenerative disorders [15].

In the traditional system of medicine, the roots and rhizomes of *Yashtimadhu* have been in clinical use for centuries. The term *Glycyrrhiza* has been derived from ancient Greek word glykos, meaning sweet and rhiza, meaning root [16]. *Yashtimadhu* consists of flavonoids, triterpene, amino acids, pectins, saponins, polysaccharides, simple sugars, mineral salts, and various other substances. Glycyrrhizin, a triterpenoid compound, accounts for the sweet taste of licorice root. These bioactive constituents contributes to the *Yashtimadhu* roots anti-inflammatpory [17] and antioxidant activity [18]. Antioxidant-based drugs or formulations are used for the treatment of complex diseases like stroke, diabetes, Alzheimer's disease and atherosclerosis [19]. The neuroprotective effect root of *Yashtimadhu* may be attributed to its antioxidant property as it possess many bioamines and active ingredients by the virtue of which susceptible brain cells get exposed to less oxidative stress resulting in reduced brain damage and improved neuronal function with improvement in memory (intelligence).

#### CONCLUSION:

Results of the present clinical study can be concluded that *Yashtimadhu* is effective in the improvement of neuropharmacological activity (medha: intelligence, memory) in adolescents instead of short term memory. *Yashtimadhu* tablet form is an acceptable form of drug in adolescent which can be explored for in memory improvement and memory dysfunction cases. Further, extensive studies are needed to know the exact mechanism of action as a potent and efficacious neuroprotective agent by isolating active compound.

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