Efficacy of *Shankhapushpi Choorna* on Borderline IQ in School Going Children - A Randomized Placebo Controlled Clinical Study

Research Article

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Abstract

Objective: To study the concepts regarding *Medha, Medhya* and IQ. Detailed assessment of IQ level of school going children with 6-8 years of age group. To study the efficacy of *Shankhapushpi Choorna* in the enhancement of IQ of school going children with Borderline IQ. Design: Open randomized placebo controlled clinical study with pre and post-test design. Setting: O.P.D. of Sri Dharmasthala Manjunatheshwara College of Ayurveda and Hospital, Udupi and also nearby schools of Udupi. Interventions: A minimum of 40 children under borderline IQ were selected based on the inclusion and exclusion criteria. The selected children were randomly divided into 2 groups of 20 each. Group A (Trial Group) were treated with *Shankhapushpi Choorna* with dose of 5grams daily at night, after food with lukewarm milk for a duration of 60 days and Group B was administered with Placebo. The follow up period was 30 days after the intervention. Main outcome measures: The subjective criteria were based on the parameters of Grasping power, Memory power, Courage & Activity. The values obtained using Malin's Intelligence Scale for Indian Children (MISIC) were considered for objective assessment. Results: Over the duration of the study, the trial drug *Shankhapushpi Choorna* was seen to have a positive effect on all the subjective and objective parameters with statistically highly significant results. Conclusion: *Shankhapushpi Choorna* with the proper dosage according to the age definitely improves the *Medha* of children with borderline IQ. The drug can be used as both promotive as well as curative aspects in accordance with intelligence.

Key Words: *Medha, Medhya Rasayana, Intelligence, Intelligence Quotient, Convolvulus pluricaulis Choisy, MISIC.*

Introduction

Kaumarabhritya is one of the important branches of *Ashtanga Ayurveda* which concerns with the complete wellbeing of children. A child is advised to be brought up from childhood to adolescence in accordance with principles of *Ayurveda* for attaining the ultimate aim of *Purusharthas* (1). Health is the integral state of normalcy of both *Sharira* as well as *Manas*. The functions attributed to the *Manas* forms the basic foundation for the phenomena of knowledge hence the dynamicity of *Manas* controls the process of cognition.

The present era eager to analyse the word Intelligence, since it has a definite impact on many human behaviours. It is having a multitude of definitions like the capacity for logic, understanding, self-awareness, learning, emotional knowledge, reasoning, planning, creativity, critical thinking and problem solving (2). IQ (the Intelligence Quotient) is the quantification of an individual's intelligence power relative to peers of a similar age by using different assessment tools. The individual's score on a modern IQ test is a good predictor of many life outcomes, including educational and career success (3).

Childhood is the timespan where the immature *dhatus* sustains the body and undergoes maximum growth and development (4). This is the apt stage for diagnosing mental vulnerabilities that most of them can make the future challenging. Definitely convenient early interventions are needed to boost the intellectual growth in children. Good mental health abides the platform for skilful development in children. A child with depreciated learning capacity does not adjust well socially (5). Mental inability is a crucial public hazard and World Health Organization estimates that 10% of the world's population has some form of mental disability and many of them are correctable if detected early.

Borderline IQ or borderline intellectual functioning is a categorization of intelligence of a person who has below average cognitive ability but the deficit is not as severe as intellectual disability. This is technically a cognitive impairment; however, this group may not be sufficiently mentally disabled but they may need some specialized care. In school age group, children with borderline IQ are often slow learners (6).

Medha can be understood as the faculty of *Buddhi* which has the power to retain the personal experiences and when needed it recalls that retained

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knowledge thus it prevents an individual from indulging into *Prajnaparadha* (7). The faculty of *Medha* can be understood as in two ways; *Grahanashakti* (Grasping Power) and *Dharanashakti* (Retention Power) (8). The textbook of *Amarakosha* explained *Medha* as the faculty needed to have proper correlation and understanding about the knowledge of the existing objects. The knowledge cannot be realized in the absence of *Medha* (9). In general, *Medha* is the power of intelligence that restores the knowledge and this restoration leads to improve the individual database of different knowledge.

Ayurveda provides the evidence-based quantum of pharmacological knowledge for the improvement of *Medha* and *Buddhi* and this is the exceeding time limit for the analysis as well as the rightful utilization of such valuable drugs for the needy ones. *Medhya Rasayana* drugs are those which improves mental faculties and intellectual functions (10). Among the *'Chaturvidha Medhya Rasayana'* (Group of four *Medhya* drugs), it has been told that *'Medhya viseshena cha Shankhapushpi'*, the foremost and excellent drug is *Shankhapushpi* among them having the potency to improve intellectual functions (11).

Shankhapushpi is a well-known herb since the most primitive authentic works on *Ayurveda* have its therapeutic utility well elaborated and its morphological characters are well described. Later on, controversies flare up as local community in different parts of India used different plant species in the name of *Shankhapushpi*. Ayurvedic Pharmacopoeia of India has established that *Convolvulus pluricaulis* is the plant species which should be taken in the name of *Shankhapushpi* and thus put an end to the controversial status of the plant moreover (12).

Our classics enlighten the promotion of *Medha, Buddhi* and *Smruti* with several formulations mentioned which impacts great potential to improve the mental power and intelligence. The effect of Ayurvedic drugs in promoting intellectual capacity should be subjected for a thorough analysis is the need of the day. Even though various pharmacological and experimental studies have proven the versatile action of *Shankhapushpi* as *medhya* drug, no documental efficacy studies are conducted on children for improvement of borderline IQ. Hence *Shankhapushpi* (*Convolvulus pluricaulis Choisy*) was selected as trial drug in the present study.

Materials and Methods
- To study the efficacy of *Shankhapushpi Choorna* in the enhancement of IQ of school going children with Borderline IQ.
- **Study design:** A randomized placebo controlled clinical study with pre-test and post-test design.
- **Source of data:** 40 Children of age group 6-8 years were selected from *Kaumarabhritya* OPD of SDM College of Ayurveda & Hospital, Udupi and also nearby schools of Udupi, Karnataka.
- **Method of collection of data**: 40 children were randomly divided into 2 groups, Group A (Trial Group) and Group B (Placebo controlled) with 20 children each.

Inclusion criteria
Students in the age group of 6-8 years irrespective of sex, caste, religion, socio-economic status having IQ of 70 to 89 (Borderline IQ).

Exclusion criteria
- Children below the age of 6 years and above the age of 8 years.
- Children having IQ less than 70 and more than 89.
- Children with Neurobehavioral disorders like ADHD, Autism and Intellectual Disability.
- Children suffering from any chronic illness, systemic disorders and on treatment.
- Children with Congenital abnormalities, Genetic disorders.
- Children with Psychiatric illness and Personality disorders.

Diagnostic Criteria
The assessment of the effect of the drug under trial was done based upon the subjective and objective criteria.

Subjective Parameters
- Grasping power
- Memory power
- Courage and Activity.

Objective Parameters
The values obtained using "Malin's Intelligence Scale for Indian Children" (MISIC) were considered for objective assessment. The test comprises of 11 subtests divided into two groups, Verbal and Performance.

Intervention
- **Drug:** *Shankhapushpi* (*Convolvulus pluricaulis choisy*) *Choorna*
- **Drug Source:** *GMP certified S D M Pharmacy, Udupi*
- **Part Used:** Whole plant

Collection & Authentication of Raw Drug
The raw drug *Shankhapushpi* in dry form was collected from the SDM Pharmacy of Ayurveda, Udupi, Karnataka state, India. The drug analysis and standardization were done at SDM Centre for Research in Ayurveda and Allied Sciences, Udupi, Karnataka state, India.

Administration Method
- Group A: Group A contained 20 children who received *Shankhapushpi Choorna* with dose of 5 grams daily at night, after food with lukewarm milk for a duration of 60 days.
- Group B: Group B contained 20 children who received Placebo (Starch powder) with dose of 5 grams daily at night, after food with lukewarm milk for a duration of 60 days.

Duration of the study
Total duration of the study: 90 days
Duration of intervention: 60 days
Follow up: 30 days

Period of Assessment

The children will be assessed on 0th day, 30th day, 60th day and on 90th day for follow up.

Statistical Evaluation

The data was coded and entered into Microsoft Excel Spreadsheet. Analysis was done using Statistical Package for Social Science (SPSS) version 20 (SPSS Inc. Chicago, IL, USA) Windows software program.

Results

Effect of treatment on Subjective Parameters

Statistical Analysis within the Group was analysed by using Wilcoxon signed - rank test and in between Group A and Group B by Mann - Whitney U test.

Group A showed highly significant improvement on Grasping Power & Memory Power, before treatment and after treatment & before treatment and on follow up. Group B showed non-significant result on every level of assessment. Group A showed significant improvement on Courage & Activity, before treatment and after treatment & before treatment and on follow up. Group B showed non-significant result on every level of assessment.

Table No.1: Results of *Shankhapushpi Choorna* for the parameter Grasping Power

BT Mean			30th day Mean			60th day Mean			90th day Mean		
2.25			2.10			1.55			1.30		
Grasping Power - GROUP A											
Grasping power	Negative Ranks			Positive Ranks			Ties	Total	Z value	P value	Inter-pretation
	N	MR	SR	N	MR	SR					
BT-30th day	3	2	6	0	0.00	0.00	17	20	-1.73	0.083	NS
BT-60th day	13	7	91	0	0.00	0.00	7	20	-3.50	0.000	HS
60th day-90th day	5	3	15	0	0.00	0.00	15	20	-2.23	0.025	S
BT-90th day	16	8.5	136	0	0.00	0.00	4	20	-3.75	0.000	HS
N - Sample size			MR - Mean Rank			SR - Sum of Ranks					

Table No.2: Results of Placebo for the parameter Grasping Power

BT Mean			30th day Mean			60th day Mean			90th day Mean		
2.45			2.40			2.40			2.45		
Grasping Power - GROUP B											
Grasping power	Negative Ranks			Positive Ranks			Ties	Total	Z value	P value	Inter-pretation
	N	MR	SR	N	MR	SR					
BT-30th day	1	1.00	1.00	0	0.00	0.00	19	20	-1.00	0.317	NS
BT-60th day	1	1.00	1.00	0	0.00	0.00	19	20	-1.00	0.317	NS
60th day-90th day	0	0.00	0.00	1	1.00	1.00	19	20	-1.00	0.317	NS
BT-90th day	0	0.00	0.00	0	0.00	0.00	20	20	0.00	1.000	NS
N - Sample size			MR - Mean Rank			SR - Sum of Ranks					

Table No.3: Results of *Shankhapushpi Choorna* for the parameter Memory Power

BT Mean			30th day Mean			60th day Mean			90th day Mean		
2.75			2.60			1.95			1.75		
Memory Power - GROUP A											
Memory Power	Negative Ranks			Positive Ranks			Ties	Total	Z value	P value	Inter-pretation
	N	MR	SR	N	MR	SR					
BT-30th day	3	2.00	6.00	0	0.00	0.00	17	20	-1.73	0.083	NS
BT-60th day	15	8.00	120.00	0	0.00	0.00	5	20	-3.77	0.000	HS
60th day-90th day	4	2.50	10.00	0	0.00	0.00	16	20	-2.00	0.043	S
BT-90th day	16	8.50	136.00	0	0.00	0.00	4	20	-3.70	0.000	HS
N - Sample size			MR - Mean Rank			SR - Sum of Ranks					

Table no.4: Results of Placebo for the parameter Memory Power

BT Mean			30th day Mean			60th day Mean			90th day Mean		
2.90			2.85			2.80			2.80		
Memory Power - GROUP B											
Memory Power	Negative Ranks			Positive Ranks			Ties	Total	Z value	P value	Inter-pretation
	N	MR	SR	N	MR	SR					
BT-30th day	1	1.00	1.00	0	0.00	0.00	19	20	-1.00	0.317	NS
BT-60th day	2	1.50	3.00	0	0.00	0.00	18	20	-1.41	0.157	NS
60th day-90th day	0	0.00	0.00	0	0.00	0.00	20	20	0.00	1.000	NS
BT-90th day	2	1.50	3.00	0	0.00	0.00	18	20	-1.41	0.157	NS
N - Sample size			MR - Mean Rank			SR - Sum of Ranks					

Table no.5: Results of *Shankhapushpi Choorna* for the parameter Courage & Activity

BT Mean			30th day Mean			60th day Mean		90th day Mean	
0.45			0.35			0.10		0.10	

Courage & Activity - GROUP A										
Courage & Activity	**Negative Ranks**			**Positive Ranks**			**Ties**	**Total**	**Z value**	**P value**	**Inter-pretation**
	N	**MR**	**SR**	**N**	**MR**	**SR**					
BT-30th day	2	1.50	3.00	0	0.00	0.00	18	20	-1.41	0.157	NS
BT-60th day	7	4.00	28.00	0	0.00	0.00	13	20	-2.64	0.008	S
60th day-90th day	0	0.00	0.00	0	0.00	0.00	20	20	0.00	1.000	NS
BT-90th day	7	4.00	28.00	0	0.00	0.00	13	20	-2.64	0.008	S

N - Sample size   MR - Mean Rank   SR - Sum of Ranks

Table no.6: Results of Placebo for the parameter Courage & Activity

BT Mean			30th day Mean			60th day Mean		90th day Mean	
0.55			0.45			0.40		0.40	

Courage & Activity - GROUP A										
Courage & Activity	**Negative Ranks**			**Positive Ranks**			**Ties**	**Total**	**Z value**	**P value**	**Inter-pretation**
	N	**MR**	**SR**	**N**	**MR**	**SR**					
BT-30th day	2	1.50	3.00	0	0.00	0.00	18	20	-1.41	0.157	NS
BT-60th day	3	2.00	6.00	0	0.00	0.00	17	20	-1.73	0.083	NS
60th day-90th day	0	0.00	0.00	0	0.00	0.00	20	20	0.00	1.000	NS
BT-90th day	3	2.00	6.00	0	0.00	0.00	17	20	-1.73	0.083	NS

N - Sample size   MR - Mean Rank   SR - Sum of Ranks

Effect of treatment on Objective Parameters

Statistical Analysis within the Group was interpreted by using Paired t test and in between Group A and Group B by Unpaired t test.

The mean score of Verbal IQ in Group A and Group B were 76.25, 76.99 before treatment and 78.13, 77.18 after treatment respectively. On follow up it was 78.73 and 77.18 respectively. There was 3.25% of improvement in Group A and 0.24% in Group B. The improvement before treatment & after treatment and before treatment and on follow up in Group A was statistically highly significant with p value <0.001 whereas statistically insignificant in Group B with p value >0.05 on every level of assessment.

The mean score of Performance IQ in Group A and Group B were 77.51, 78.29 before treatment and 79.04, 78.39 after treatment respectively. On follow up it was 79.40 and 78.39 respectively. There was 2.43% of improvement in Group A and 0.12% in Group B. The improvement before treatment & after treatment and before treatment and on follow up in Group A was statistically highly significant with p value <0.001 whereas statistically insignificant in Group B with p value >0.05 on every level of assessment.

The mean score of Verbal IQ in Group A and Group B were 76.88, 77.64 before treatment and 78.58, 77.78 after treatment respectively. On follow up it was 79.08 and 77.78 respectively. There was 2.86% of improvement in Group A and 0.18% in Group B. The improvement on before treatment & on 30th day, before treatment & after treatment and before treatment and on follow up in Group A was statistically highly significant with p value <0.001 whereas statistically insignificant in Group B with p value >0.05 on every level of assessment.

Table no.7: Results of *Shankhapushpi Choorna* for the parameter Verbal Scale

VERBAL SCALE - GROUP A								
Verbal Scale	**Mean Score**	**Difference in Mean**	**Paired t Test**					**Interpretation**
			% change	**Standard Deviation**	**Standard Error Mean**	**t value**	**P value**	
BT	76.25	-0.72	0.94%	3.09	0.69	-4.14	0.001	HS
30th day	76.97			3.22	0.72			
BT	76.25	-1.88	2.46%	3.09	0.69	-6.81	0.000	HS
60th day	78.13			3.20	0.71			
60th day	78.13	-0.60	0.76%	3.20	0.71	-3.52	0.002	S
90th day	78.73			3.22	0.72			
BT	76.25	-2.48	3.25%	3.09	0.69	-6.86	0.000	HS
90th day	78.73			3.22	0.72			

Table no.8: Results of Placebo for the parameter Verbal Scale

Verbal Scale	Mean Score	Difference in Mean	% change	Standard Deviation	Standard Error Mean	t value	P value	Interpretation
				Paired t Test				**Interpretation**
BT	76.99	-0.16	0.20%	2.81	0.62	-1.50	0.148	NS
30th day	77.15			2.95	0.66			
BT	76.99	-0.19	0.24%	2.81	0.62	-1.48	0.153	NS
60th day	77.18			2.98	0.66			
60th day	77.18	-	-	2.98	0.66	-	-	Statistics cannot be computed
90th day	77.18			2.98	0.66			
BT	76.99	-0.19	0.24%	2.81	0.62	-1.69	0.153	NS
90th day	77.18			2.98	0.66			

Table no.9: Results of *Shankhapushpi Choorna* for the parameter Performance Scale

Performance Scale	Mean Score	Difference in Mean	% change	Standard Deviation	Standard Error Mean	t value	P value	Interpretation
				Paired t Test				**Interpretation**
BT	77.51	-0.48	0.60%	3.99	0.89	-2.79	0.012	S
30th day	77.99			3.96	0.88			
BT	77.51	-1.53	1.97%	3.99	0.89	-4.47	0.000	HS
60th day	79.04			3.96	0.88			
60th day	79.04	-0.36	0.45%	3.96	0.88	-1.86	0.077	NS
90th day	79.40			4.02	0.90			
BT	77.51	-1.89	2.43%	3.99	0.89	-5.55	0.000	HS
90th day	79.40			4.02	0.90			

Table no.10: Results of Placebo for the parameter Performance Scale

Performance Scale	Mean Score	Difference in Mean	% change	Standard Deviation	Standard Error Mean	t value	P value	Interpretation
				Paired t Test				**Interpretation**
BT	78.29	-0.10	0.12%	2.93	0.65	-1.69	0.106	NS
30th day	78.39			2.91	0.65			
BT	78.29	-0.10	0.12%	2.93	0.65	-1.69	0.106	NS
60th day	78.39			2.91	0.65			
60th day	78.39	-	-	2.91	0.65	-	-	Statistics cannot be computed
90th day	78.39			2.91	0.65			
BT	78.29	-0.10	0.12%	2.93	0.65	-1.69	0.106	NS
90th day	78.39			2.91	0.65			

Table no.11: Results of *Shankhapushpi Choorna* for the parameter Full Scale IQ

Full Scale IQ	Mean Score	Difference in Mean	% change	Standard Deviation	Standard Error Mean	t value	P value	Interpretation
				Paired T Test				**Interpretation**
BT	76.88	-0.60	0.78%	3.40	0.76	-5.9	0.000	HS
30th day	77.48			3.42	0.76			
BT	76.88	-1.70	2.21%	3.40	0.76	-8.78	0.000	HS
60th day	78.58			3.37	0.75			
60th day	78.58	-0.49	0.62%	3.37	0.75	-3.25	0.004	S
90th day	79.08			3.40	0.76			
BT	76.88	-2.20	2.86%	3.40	0.76	-9.04	0.000	HS
90th day	79.08			3.40	0.76			

Table no.12: Results of Placebo for the parameter Full Scale IQ

Full Scale IQ	Mean Score	Difference in Mean	% change	Standard Deviation	Standard Error Mean	t value	P value	Interpretation
FULL SCALE IQ - GROUP B								
				Paired t Test				
BT	77.64	-0.13	0.16%	2.66	0.59	-2.02	0.057	NS
30th day	77.77			2.67	0.59			
BT	77.64	-0.14	0.18%	2.66	0.59	-1.96	0.064	NS
60th day	77.78			2.67	0.59			
60th day	77.78	-	-	2.67	0.59	-	-	Statistics cannot be computed
90th day	77.78			2.67	0.59			
BT	77.64	-0.14	0.18%	2.66	0.59	-1.96	0.064	NS
90th day	77.78			2.67	0.59			

Comparison between the groups for subjective & objective parameters implied that Group A showed better results with p value <0.001 which is statistically highly significant. Hence *Shankhapushpi Choorna* proved its efficacy on improvement of borderline IQ.

Graph No.1: Showing comparative effect on Grasping Power in Group A & B

Graph No.2: Showing comparative effect on Memory Power in Group A & B

Graph No.3: Showing comparative effect on Courage & Activity in Group A & B

Graph No.4: Showing comparative effect on Verbal IQ Score in Group A & B

Graph No.5: Showing comparative effect on Performance IQ Score in Group A and B

Graph No.6: Showing comparative effect on Full Scale IQ Score in Group A & B

Discussion

The time validated documentation of the eternal concepts of Ayurveda which explores the practical application is vital for the conservation of health of the present era. Intellectual assessment and intelligence testing are an approach that gives an idea of individual's general intellectual functioning and cognitive abilities. General intellectual functioning typically assigns to one's global or overall level of intelligence, often referred to as Intelligence Quotient (IQ) (13). The typical feature of borderline IQ is that they exhibit less positive and less sensitive behaviour as compared to peers. But they are less behaviourally troublesome than

that of the children with other behavioural problems. They can be considered as the vulnerable group whom needs special interventions and it will definitely make improvement in their demanding issues (14).

IQ tests are sensitive to a number of cognitive difficulties and answers a number of questions about the distinctive nature of children of the same age. It is a powerful standard of the integrity of the individual child's problem - solving system. The review of intellectual strengths and weaknesses provides important information about the child's specific educational needs. When IQ tests are used with other cognitive measures, a clinician is able to obtain key information about the child's learning style resulting in

appropriate recommendations for educational intervention, modification or accommodation (15). Malin's Intelligence Scale for Indian Children (MISIC) is the Indian adaptation of Wechsler's Intelligence Scale for Children is used to assess the IQ of the children that provide scores on Verbal IQ, Performance IQ and Full-Scale IQ (16). MISIC includes tests based on Information, Comprehension, Arithmetic, Similarities, Vocabulary, Digit Span, Picture Completion, Block Design, Object Assembly, Coding and Mazes is the ideal tool for assessment of each and every aspect of IQ of children.

Acharya Charaka defines *Buddhi* as the one which determines the specific qualities of the objects and impels the individual to speak or act intelligently. *Buddhi* is the matter responsible for conclusive knowledge. According to *Chakrapani*, *Buddhi* gives an initiation to work and to come to final conclusion after proper analysis (17). The key instruments of knowledge are *Manas*, *Buddhi* and *Indriyas*. Their interrelation with the empirical soul results in *Karma, Vedana* and understanding. Without this association nothing exists accordingly (18).

The critical analysis of the unique concept of *Medha* is only possible if the available scattered references are well organized. *Medha* is a faculty of *Buddhi* that can be interpreted as a specific psychic ability which is responsible for encoding and retaining a large amount of knowledge. Though the terms *Dhee, Buddhi* etc. are used synonymously to *Medha*, practically these are the separate entities having individual role. *Buddhi, Medha, Dhee*, *Dhruti* and *Smruti* can be considered as the peculiar aspects of human intellectual entities. The term *Medhya* in *Ayurveda* is described in a comprehensive way. It comprises of all the three mental faculties - *Dhee, Dhruti* and *Smruti* those are interrelated with each other in their functional aspects. *Medhya* can also be fractionalized into *Grahanashakti* (Power of Grasping), *Dharanashakti* (Power of Retention), *Vivekashakti* (Power of Discrimination) and *Smruti* (Power of Recollection) (19). *Medhya Rasayanas* are a group of medicinal plants with multi benefits specially to improve memory and intellect by its *Prabhava* (specific action). These drugs are known to have determined effects on mental performance by enhancing the functions of *Buddhi* and *Manas*.

As per *Acharya Charaka, Rasayana* is defined as the means of achieving the finest quality of *Rasadi Dhatus* where it promotes life span, improves *Medha*, cures diseases, stabilizes youthfulness, improves lustre, complexion, voice and makes body and senses strong and healthy (20). *Rasayana* drugs generally serves as Immunomodulator, Adaptogen, Antioxidant and Nootropic measures. Nootropic drugs will promote intellectual functions and brain integrity points towards the *Medhya Rasayanas*. *Medhya* drugs having the capacity to act at different levels in our body; at the level of *Rasa*, acts by stimulating and improving the functions of *Agni*, improves circulation of *Rasa* by *Srotosodhana guna* thus improving *Medhya* function.

Guru Snigdha Picchila Saraguna along with *Seetavirya* and *Madhuravipaka* of *Shankhapushpi* promotes *Tarpaka & Avalambaka Kapha* thus enhances *Dharanakarma* and does *Mastishkaposhana* improving the power of retention. *Acharya Vagbhata* highlighting the *Medhya* action of *Tiktarasa* which is the *pradhanarasa* of *Shankhapushpi* (21). *Shankhapushpi* being *Tikta Katu rasa* predominance, promotes *Pitta* and enhances *Grahana* and *Smarana* (Grasping Power & Memory). The *Deepana, Pachana* and *Srotosodhana guna* of the drug will enhances the *Pachaka, Sadhaka* and *Alochaka Pitta* qualities and act at the level of *Manovaha* and *Rasavaha Srotas* thus regulating its normal functioning. Since all the *Tridoshas* are involving in the vitiation of normal functioning of the *Manas*, drug with *Tridoshasamaka* property is necessary for the demand. *Shankhapushpi* by its *Tridoshasamaka* properties and *Vata* (Regulator of *Manas*) controlling activity, helps to normalize the involvement of *Manodosha (Rajas & Tamas)*. The factors *Cintya, Vicharya, Uhya, Dhyeya* and *Sankalpya,* emphasizes the whole memory process will regulated by the *Medhya* and *Tridoshasamaka* properties of *Shankhapushpi*.

Nootropics are the pharmacological group referred to as Brain tonics, Memory enhancers and Cognitive boosters. Nootropics are thought to work by altering the availability of supply of neurochemicals (neurotransmitters, enzymes and hormones) to the brain, by improving the brain's oxygen supply or by stimulating nerve growth that helps to enrich the functional aspects of the brain. Several types of chemical constituents like Alkaloids, Terpenoids, Phenolics, Flavonoids and Coumarins are reported scientifically for the pharmacodynamics of intellect and memory boosting action of the drug *Shankhapushpi*. Different studies concluded the neuroprotective activity of the drug is by lowering Beta-Amyloid deposition in the brain offers protection from memory dysfunction. Also, the underlying mechanism considering free radical scavenging and antioxidant action on the brain cells, will provide protective action against brain aging. *Shankhapushpi* is being an AchE inhibitor, which protect the loss of neurotransmitter AchE, directly responsible for the cognitive functions (22).

Conclusion

Over the duration of the study, the trial drug *Shankhapushpi Choorna* was seen to have a positive effect on all the subjective and objective parameters with statistically highly significant results. Hence it can be concluded that *Shankhapushpi Choorna* with the proper dosage according to the age definitely improves the *Medha* of children with borderline intellectual functioning. The drug can be used as both promotive as well as curative aspects in accordance with intelligence.

References

1. Sreekumar T. Astanga Hrdaya of Vagbhata. 1st edition. Thrissur; Publication department, Harisree Hospital; 2008. p.25.
2. Gayle A. Brazeau. Is There Time for Student Intellectual Development and Scholarly Pursuits. Am J Pharm Educ. March, 2010; 74(2); p.18.
3. https://www.researchgate.net/IQ (The Intelligence Quotient). dated 04-02-2020 time 16:30 IST.
4. Sharma R.K & Bhagwan Dash. Caraka Samhita with Cakrapani Datta's Ayurveda Dipika. 1st edition. Varanasi; Chaukhamba Sanskrit Series office; 2010. p.277.
5. Pramod Shukla Shailendra, Chitrakar. M. Efficacy of Jyothishmati Oil with Pranayama on IQ. International Journal of Ayurveda and Pharma Research. August, 2015; 3(8); 100.
6. The Best Test Preparation for the Advanced Placement Examination in Psychology, Research & Education Association. 2003, p.99.
7. Sharma R.K & Bhagwan Dash. Caraka Samhita with Cakrapani Datta's Ayurveda Dipika. 1st edition. Varanasi; Chaukhamba Sanskrit Series office; 2010. p.336-338.
8. Sharma R.K & Bhagwan Dash. Caraka Samhita with Cakrapani Datta's Ayurveda Dipika. 1st edition. Varanasi; Chaukhamba Sanskrit Series office; 2010. p.166.
9. Bhanuji Diksita. Sastri Haragovinda. Namalinganusasana or Amarakosha of Amarasimha. 1st edition. Varanasi; Chaukhambha Sanskrit Sansthan; 2016. p.72.
10. Byadgi S. Parameswarappa, Pandey Kumar Ajai. A textbook of Kayacikitsa. 1st edition. Varanasi; Chaukhambha Sanskrit Sansthan; 2018. p.916.
11. Sharma R.K & Bhagwan Dash. Caraka Samhita with Cakrapani Datta's Ayurveda Dipika. 1st edition. Varanasi; Chaukhamba Sanskrit Series office; 2010. p.46.
12. Ayurvedic Pharmacopoeia of India. Part 1, Vol 2; p.147.
13. Ortiz O. Samuel, Lella A. Stacey. Intellectual ability and assessment: A primer for parents and educators. NASP. 2010; P.S2H12/1-4.
14. Wieland Jannelien, Zitman G. Frans. It is time to bring borderline intellectual functioning back into the main fold of classification systems. BJPsych Bull. August, 2016; 40(4); p.204-206.
15. Holdnack A. James. Defining the role of intellectual and cognitive assessment in special education. The Psychological Corporation, a Harcourt Assessment Company; Psychology. 2003; p.12.
16. Malin A. J. Manual of Malin's Intelligence Scale for Indian Children. Lucknow: Indian Psychological Corporation. Chapter 2, General Description of the WISC and MISIC; p.3.
17. Sharma R.K & Bhagwan Dash. Caraka Samhita with Cakrapani Datta's Ayurveda Dipika. 1st edition. Varanasi; Chaukhamba Sanskrit Series office; 2010. p.317.
18. Sharma R.K & Bhagwan Dash. Caraka Samhita with Cakrapani Datta's Ayurveda Dipika. 1st edition. Varanasi; Chaukhamba Sanskrit Series office; 2010. p.325.
19. Ray Suman. Ray Asim. Medhya Rasayanas in Brain function and Disease. Medicinal Chemistry. 2015; 5(12); p.505-506.
20. Sharma R.K & Bhagwan Dash. Caraka Samhita with Cakrapani Datta's Ayurveda Dipika. 1st edition. Varanasi; Chaukhamba Sanskrit Series office; 2010. p.8.
21. Sreekumar T. Astanga Hrdaya of Vagbhata. 1st edition. Thrissur; Publication department, Harisree Hospital; 2008. p.275.
22. Sethiya N. K. Mishra S. H. Neuropharmacological evaluation on four traditional herbs used as nervine tonic and commonly available as Shankhapushpi in India. Journal of Ayurveda and Integrative Medicine. January-March, 2019; 10(1); p.25-31.

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