



Research Article

**A STUDY ON IMPROVEMENT OF IQ LEVEL IN BORDERLINE MENTALLY RETARDED CHILDREN BY THE USE OF BRAHMI GHRITA AND JYOTISHMATI TAIL**

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**ABSTRACT**

Ayurveda is a life science having *Prayojana* (ultimate aim) prevention is better than cure and if patient is suffering from any disease then cure early. Health of body totally depends upon mind health. In Ayurvedic texts certain medications are prescribed for mental health and to treat underlying diseases such as *Jadatva*, *Mandabuddhitva* (mental retardation), which comes under the category cognitive deficit. Among various cognitive deficits, borderline mental retardation is an important entity which is a part of the cognition. In Ayurveda, there are some drugs which are more effective in mental retardation especially in the borderline mental retardation. The present research work has been planned to study only borderline mental retarded children with the use of *Brahmi ghrita & Jyotishmati tail*. In IQ level, the mean score before treatment was 80.06 which were increased to 81.56 after treatment showing 1.92% improvement. The result found was statistically highly significant with 'p' value <0.001. This may be due to the *Medhya prabhavas* of drugs like *B. monnieri* and *C. paniculatus* which increases grasping and intellectual ability. Past studies also supports this data. *B. monnieri*, *C. pluricaulis* have proven improved learning and memory enhancing activity (intellectual functions).

**KEYWORDS:** Mental retardation, *Brahmi ghrita*, *Jyotishmati tail*.

**INTRODUCTION**

The human brain remains a mystery today even after years of research into the biological process underlying its specific actions. In addition to controlling and coordinating vital life processes, the brain regulates higher level operations such as cognition and memory, functions that provide us with the capacity to think, reason, and act. These mental abilities however have been observed to diminish significantly with advancing age.

Modern era believe only on scientific basis. They demands not only better quality of life but also demands an efficient and effective life. To survive in such a huge competition every parent wants his child to be an excellent position in every field by using his/her super-mind with superior cognitive functions. But in the developing countries, still there is no valuable attention towards the problem of cognitive deficit. Due to this, a large number of children are suffering from cognitive or psychiatric impairment during their course of development.

Overall, mental retardation occurs more frequently in boys than in girls: 2:1 in mild mental retardation and 1.5:1 in severe mental retardation.

This may be a consequence of X-linked disorders, the most prominent being fragile X syndrome.<sup>[1]</sup>

The most commonly used definition of mental retardation comes from the American Psychiatric Association's (APA) Diagnostic and Statistical Manual of Mental Disorders, Fourth Edition, Text Revision (DSM-IV-TR) as "below-average, or impaired, abilities in cognitive and adaptive functioning."-Thus, mental retardation is the correct diagnosis only when an individual has both cognitive deficits and poor adaptive behavior skills.

Although this condition is not met as a disease moiety in separate chapters of Ayurvedic classics, but many references of conditions like *Jada*, *Murkha*, *Alpabuddhinam* and *Mandabuddhitva* in Ayurvedic classics indicate impaired *Buddhi*. An Ayurvedic approach to its understanding and treatment protocol can be given on the basis of the fundamentals of Ayurveda.

Various etiological factors like dishonored longings of a pregnant woman, excessive consumption of *Vata vardhaka ahara*, intake of alcohol, excessive sleeping by a pregnant lady vitiate the *Doshas* (the *Vata dosha* mainly). This provoked

*Vata* either directly reaches the foetal heart through *Nabhinadi* or may form an *Avarana* i.e. *pranavrita Samana*, which results into *Jada* or Aggravated *Vata*, vitiates *Kapha* and the two reaches the foetal heart, through the *Nabhinadi*. The *Doshic* predominance in *Balyavastha* is that of *Kapha*, *hridaya* too, is a seat of *Kapha dosha*. Thus *Vata* along with *Kapha* obstruct the functions of entities having their seat in the *Hridaya* such as. On the other hand, *kapha* itself is dominated by *Tamobhava*.

The hypo *Manas*, *Buddhi*, *Pranavayu*, *Udanavayu*, *Sadhaka pitta*, *Alochaka pitta (buddhi vaisheshika)* and *Oja* function of all these entities and higher concentration of *Tamasa guna* can manifest into the hypo functioning of *Buddhi*. During delivery, if there is any trauma (*Abhigata*) especially on head, which is also a seat of *Indriyas*, it may affect the *Indriyas* leading into hypo functioning of the *Buddhi*. In the postnatal period, *Kaphaja* milk feeding to a child provokes the *Kaphadosha* and this aggravated *Kapha* creates *Sanga* (obstruction) in the *Manovaha srotas* in the *Hridaya* which is the seat of *Buddhi* and its functional units. It results into the impaired genesis of knowledge causes *Jada* or *Mandabuddhitwa* in a child.

## Clinical Study

### Aims and Objectives

#### Primary Objectives

- To assess the clinical efficacy of *Brahmi Ghrita* and *Jyotishmati Taila* in the management of Borderline Mentally Retarded Children.

#### Secondary Objectives

- To assess the clinical safety of *Brahmi Ghrita* and *Jyotishmati Taila* in the children suffering from Borderline Mental Retardation.

### Materials and Methods

**Study Type:** Interventional

**Purpose:** Treatment

**Masking:** Open label

**Control:** Not controlled

**Timing:** Prospective

**End Point:** Efficacy and Safety

**No. of Groups:** One

Number of Patients to be completed in the clinical trial (Sample Size: 50).

### Selection of Cases

Children for the present study were screened out from OPD/IPD of Balrog Department of National Institute of Ayurveda, Jaipur (Rajasthan) and from various schools, situated in Jaipur by survey method.

### Timelines:

**Total Study Period:** 18 months

**Washout / Preparatory Period (if required):** 4 weeks

**Recruitment:** 11 months

**Treatment Period:** 12 weeks

**Follow-Up Period:** 4 weeks

**Statistical Analysis:** 2 months

### Study Drug

**1. Brahmi Ghrita** (API – Part II; Vol I; pg 63-64).

**Dose:** 10 gm twice daily

**Dosage form:** Ghrita

**Route of Administration:** Oral

**Time of Administration:** Twice a day before food

**Packing form:** 300 gm pet jar

**Anupana:** Luke warm water / milk

**Duration of therapy:** 12 weeks

**2. Jyotishmati Taila** (API – Part – I; Vol – II; Pg 65-67)

**Dose:** 2 drops twice daily in each nostril

**Dosage form:** Oil

**Route of Administration:** Nasal

**Time of Administration:** Twice a day

**Packing form:** 15 ml plastic bottle with a dropper

**Duration of therapy:** 12 weeks

*Jyotishmati tail* was prepared by standard procedure from its seeds as per reference API part I, volume 2, page 65-67, contains single drug *Jyotishmati*.

**Table 1: Formulation composition: Each 10 gm Ghrita contains**

Sr. No.	Drug	Part used	Contain
1.	<i>Brahmisvarasa (Bacopa monneri)</i>	Plant whole	20 ml
2.	<i>Vidanga (Embelia ribes)</i>	Fruit	0.156 gm
3.	<i>Pippali (Piper longum)</i>	Fruit	0.156 gm
4.	<i>Shankhapushpi (Convolvulus pluricaulis)</i>	Plant whole	0.156 gm
5.	<i>Shunthi (Zingiber officinlae)</i>	Rhizome	0.156 gm
6.	<i>Maricha (Piper nigrum)</i>	Fruit	0.156 gm
7.	<i>Shyama (Ipomoea turpethum)</i>	Root	0.156 gm

8.	<i>Trivrit (Operculina turpethum)</i>	Root	0.156 gm
9.	<i>Danti (Baliospermum montanum)</i>	Root	0.156 gm
10.	<i>Nripdruma (Cassia fistula)</i>	Fruit pulp	0.156 gm
11.	<i>Saptala (Euphorbia dracunculoides)</i>	Plant whole	0.156 gm

### Diagnostic criteria

#### Inclusion Criteria

1. Children of either sex aged between 8 to 13 years
2. Children with Intelligence Quotient 70-84 (Wechsler's-IQ Indian adaptation by Malin).
3. Willing and able to participate for 16 weeks. (Assent to be obtained from Parent(s) / Guardian(s)).

#### Exclusion Criteria

1. Children suffering from major systemic illness necessitating long term drug treatment.
2. Children with evidence of malignancy.
3. Children with concurrent serious Hepatic Dysfunction (defined as AST and/or ALT >3 times of the upper normal limit) or Renal Dysfunction (defined as S. creatinine >1.2mg/dl) Uncontrolled Pulmonary Dysfunction (asthmatic and COPD patients).
4. H/o hypersensitivity to any of the trial drug or their ingredients.
5. Children who have completed participation in any other clinical trial during the past six (06) months.
6. Any other condition which the P.I. thinks may jeopardize the study.

#### Withdrawal Criterion

- a) The child may be withdrawn from the trial if there is
- Any major ailment or Progressive IQ decline, necessitating the institution of new modalities of treatment.
  - Non-compliance of the treatment regimen

#### Outcomes

- Change in IQ level

#### Methods of Assessment

##### Prior to selection - (Screening)

- Informed Consent /Assent
- Eligibility evaluation
- Laboratory investigations

##### During Selection - (Baseline)

- General information - (Personal Identification and Demographic profile).
- Medical history, General Physical and Systemic examination.
- Assessment of IQ (Wechsler's-IQ Indian adaptation by Malin).

- Assessment of Ayurvedic Parameters.
- Issue of drugs.
- Instructions to come after 2 weeks (14 days).

##### During Treatment i.e. on 14th day, 28th day, 42nd day, 56th day, and 70th day

- Assessing drug compliance
- Physical examination.
- Issue of drugs
- Instructions to come after 2 weeks (14 days).

##### At the end of the treatment i.e. at the end of 12 weeks (84th day)

- Assessing drug compliance.
- Assessment of IQ (Wechsler's-IQ Indian adaptation by Malin).
- Assessment of Ayurvedic Parameters.
- Laboratory Investigations.
- Instructions to come after 4 weeks

##### Assessment at the end of 16 weeks

- Assessment of IQ (Wechsler's-IQ Indian adaptation by Malin)

#### Ethics

The trial was conducted in accordance with ethical principles that have their origin in the Declaration of Helsinki for biomedical research and ICMR ethical guidelines involving human participants (2006), and that are consistent with Indian / ICH Good Clinical Practice (GCP) guidelines.

#### Institutional Ethics Committee

Prior to commencement of the trial, the protocol, the participant information sheet and the consent form was submitted to the Institutional Ethics Committee. Written approval of the same was obtained from the IEC. Protocol amendments were also to be approved by the IEC according to the usual procedure.

#### Patient Information and Consent/Assent Form

Prior to any trial related activity, the Principal Investigator was give the patient verbal and written information about the trial in a form the participant/ Parent(s)/Guardian(s) can read and understand. The Investigator could ensure that the participant is fully informed about the aims, procedures, discomforts and expected benefits of the trial. It was emphasized that participation was voluntary and participants have the right to opt out of the trial at any time

without any prejudice. A voluntary, signed witnessed Informed Consent/Assent was obtained from the Participant/Parent(s)/Guardian(s) prior to any clinical trial related procedure.

### Wechsler's Intelligence Scale

Two main reasons for his preference for the WISC are the simplicity of its administration and its analytical breakdown into factorial functions for vocational and educational guidance. Unlike the several dozen unrelated test items of the Binet whose smooth manipulation requires long training, the ten WISC subtests are rapidly and easily learned.

The original WISC (Hindi Version) is an individual intelligence test or scale for children from

the ages of 5 to 15.11. The Indian adaptation covers only 10 years from 6 to 15.11.

The original Scale comprises twelve subtests divided into Verbal and Performance groups as follows:

**Verbal-**1) Information 2) Comprehension 3) Arithmetic 4) Similarities 5) Vocabulary 6) Digit span

**Performance-**1)Picture completion 2)Picture arrangement 3)Block design 4)Object assembly 5) Coding 6) Mazes

### OBSERVATIONS AND RESULTS

A total of 50 children were included for the study, of which all the 50 children completed the study.

The detailed pattern of the study as shown as below.

### Observations related to Demographic pattern

Table 2: Showing the demographic data

Incidence	Predominance	Percentage (%)
Age	8-9 years	28%
Sex	Male	74%
Religion	Hindu	54%
Socio-economic status	Above poverty line	68%
Child education	1 <sup>st</sup> to 3 <sup>rd</sup>	76%
Gestational age	Full term	98%
Cry at birth	Normal	96%
Nutritional status	Moderately nourished	44%
Built status	Average	42%
Body mass index	Starvation	44%
Diet	Vegetarian	54%
Bowel habit	Regular	94%
Prakriti	Pitta-kaphaja	46%
Sara	Mamsa sara & Rakta sara	32% each
Samhanana	Madhyama	44%
Satmya	Madhyama	54%
Satva	Madhyama	64%
Ahara shakti	Madhyama	60%
Vyayama shakti	Madhyama	54%
IQ score	80-82	52%

Table 3: Observation Related to IQ score wise distribution (n=50)

IQ Score Range	Total	%
71-73	01	02.00
74-76	03	06.00
77-79	13	26.00
80-82	26	52.00
83-84	07	14.00

Maximum (52%) numbers of patients were found in the IQ range 80-82 followed by 26% patients in the range 77-79. In the range, 83-84, 74-76 and 71-73, only 14% patients, 6% and 2% patients were found respectively (Table 03).

**Table 4: Results Related to improvement in IQ level**

Parameters	Mean Score			% Change	S.D.	S.E. (±)	't'	'p'	Remark
	B.T.	A.T.	Diff.						
IQ	80.06	81.56	-1.54	-1.92	0.78	0.11	13.82	<0.001	H.S.

The mean score before treatment of IQ was 80.06 which was increased to 81.56 after treatment showing 1.92 % improvement. The result found was statistically highly significant (p<0.001) (Table 04).

**DISCUSSION**

This study was conducted to evaluate the effectiveness of “*Brahmi Ghrita*” and “*Jyotishmati Tail*” in the management of borderline mental retardation in children. Overall 50 children were screened out on the basis of assessment criteria of IQ through WISC (Wechsler’s Intelligence Scale, Indian adaptation by Malin’s) having IQ level in between 70 to 84. The study was completed by all the 50 children. These cases were selected from OPD/IPD of National Institute of Ayurveda, Jaipur. Data was collected before treatment, at follow ups and after treatment which was statistically analyzed and discussed in detail and the outcome is mentioned here below. The results were observed and evaluated for laboratory parameters and IQ level.

The clinical efficacy of the drug was analyzed statistically on all parameters mentioned in the assessment criteria. The obtained results of laboratory parameters and IQ level were statistically analyzed by using “Students paired ‘t’ test” for the significance of effect seen in individuals.

**Discussion Regarding the Demographic Data**

**Age-** Age range of selected children was between 8 to 13 years according to applicability of the diagnostic test. (WISC is applicable for the children aged between 6 to 16 years). In this study, Maximum numbers (28%) of patients were in the age group 8-9 years followed by 26% children in the age group 10.1-11 years. 18% each belongs to the age group 12.1-13 years and 9.1 to 10 years. Remaining 10% belongs to the age group 11.1-12 years.

The high incidence in 8 to 9 years may be attributed to faulty food habits (*Viruddha Ahar Sevan*) which is one of the reason of *Majja Dhatu Dushti*<sup>[2]</sup> finally *Mandabuddhitva*.

**Sex-** Male predominance with 74% was observed over females. The higher incidence of borderline mental retardation in males may be because of the parents are more conscious for male child’s health and there is a belief among the parents that boys are more in need in special services than girls so bring them to hospital. Past studies also support this data.

**Religion-** Children of the Hindus community are most affected by borderline mental retardation. Hindus constitutes 54% as compared to 46% Muslims. In the present study, dominancy of Hindus may due to more Hindu population around hospital periphery. This data proves the geographical distribution of particular area.

**Socio-economic Status-** In patients above poverty line, higher incidence of borderline mental retardation was found (68%) as compared to below poverty line patients (32%). In this study, lesser percentage among below poverty line may be due to their lesser awareness for their child health.

**Child Education Status-** The data reveals that majority of children (76%) were studying in standard 1<sup>st</sup> to 3<sup>rd</sup> followed by 24% children were in studying in 4<sup>th</sup> to 5<sup>th</sup> standard. All the patients were found to trail back in their school. Repeated failure in the first few year of school was recorded in maximum cases showing that these children could not learn even the basic academic skills in the schools meant for normal children.

**Gestational Age-** In the present study, maximum number of children (98%) had a birth history of full term delivery. It may be due to good care of mother during antenatal period as the maximum children were from high socioeconomic status that is above poverty line.

**Cry at Birth-** It was seen that majority of the patients had a history of normal cry or immediate cry which was in 96% of cases while a delayed cry after birth was reported in 4% of the patients. Establishment of respiration in the body is reflected by his cry. In case a history of delayed cry is given, it indicates incidence of birth asphyxia which causes an insult to the brain. The optimum requirement of glucose and oxygen of a neonate is very high. Lack of oxygen leads to significant damage of the brain that may manifest in the form of mental insufficiency. In the present study, maximum deliveries were in hospital so the incidence of birth asphyxia or brain insult is very less hence the only 4% of patients of borderline mental retardation showed delayed cry.

**Nutrition-** It was seen that 44% of the total patients were moderately nourished followed by 38% malnourished and 18% children were well nourished. It may be due to maximum number of children were from above poverty line so their nutrition was good/moderate so in the present study 44% children were found moderately nourished.

It has been generally seen that in case, one of the children is mentally retarded, the parents start paying more attention on to the other children hence may be due to this reason, 38% children were malnourished in the present study.

**Built-** In the present study, average built was found in maximum numbers of children (42%) followed by 40% children emaciated and 18% are well built. The reason may be the same as above described during nutrition that maximum numbers of children were from above poverty line so their nutrition was good or average so the built found was average.

It has been generally seen that in case, one of the children is mentally retarded, the parents start paying more attention on to the other children hence may be due to this reason, 40% children were found emaciated in spite of having good socioeconomic condition of family.

**Body Mass Index-** In the present study, starvation was found in 44% children followed by 28% children equally having underweight and normal range. This may be due to the same reason as described above during nutrition and built.

**Diet-** Study included almost equal numbers of cases with vegetarian (54%) and non-vegetarian diet (46%). No relation of diet with incidences of borderline mental retardation can be established from this data as the patients came to the hospital from surrounding area were predominant in both vegetarian and non-vegetarian diet.

**Bowel Habit-** The data in this study showed that the most of children (94%) reported regular bowel habit and only 6% children had irregular bowel habit. This may be due to the present age shows *Kapha dosha* dominance due to which bowel habit may be regular in maximum children.

**Prakriti-** Study included maximum number of cases with *Pitta-Kapha Prakriti* (46%) followed by 34% children with *Vata-Pitta Prakriti*. This may be due to pathogenesis of borderline mental retardation involves vitiated *Tridosha*. Another reason is that the symptoms of borderline mental retardation are comparable to that of mentioned in individuals with *Vata* and *Kapha Prakriti*.

**Sara-** Study included equal numbers of cases with *Rakta Sara* (32%) and *Mamsa Sara* (32%) followed by 24% children of *Asthi Sara*. In present study, *Majja*

*Sarata* was not found in any one child. This reason may support the study that all the children suffering from borderline mental retardation deficit may does not have *Majja sarata*.

**Samhanana-** It was seen that 44% of total patients had a *Madhyama samhanana* followed by 34% had an *Avara samhanana* and 22% *Pravara samhanana*. In the severely and moderately retarded children compactness of body is not proper while in borderline and most of the mildly retarded children the compactness may be almost near to normal but usually it's never very good hence in the present study, compactness may be near to normal that is *Madhyama samhanana* in maximum children present.

**Satmya-** 54% children had *Madhyama satmya* and 36% had an *Avara satmya*. *Satmya* stands for such factors as are wholesome to the individual even when continuously used that is Homologation. In the present study, maximum children had *Madhyama* and an *Avara satmya* and hence the observation of the present study shows that subjects studied were not getting proper wholesome care both for body and mind.

**Satva-** In maximum number of patients (64%), the *Satva* was found to be *Madhyama* followed by 32% *Avara satva*. The severely, moderately mentally retarded children usually lack of self confidence, they are not self dependent and judge the situation properly. The borderline mentally retarded children may show some confidence, will power and judgment.

**Ahara Shakti-** *Madhyama ahara shakti* was observed in maximum children (60%) followed by 30% children had an *Avara ahara shakti*. *Ahara shakti* is just the reflection of *Agni* and *Agni* found in maximum number of patients was *Madhyama* so the *Ahara shakti* found was *Madhyama* in maximum number of patients.

**Vyayama Shakti-** In maximum number of children that is 54%, the *Vyayama shakti* was *Madhyama* while in 36% children, it was found to be an *Avara*. Due to the fact that, growth is also affected in most of these cases, the compactness and *Sarata* of *Dhatu* being less. These children cannot do strenuous exercise.

**IQ Score-** Maximum (52%) numbers of patients were found in the IQ range 80-82 followed by 26% patients in the range 77-79. In the range, 83-84, 74-76 and 71-73, only 14% patients, 6% and 2% patients were found respectively (Table. 03). IQ level- The mean score before treatment was 80.06 which were increased to 81.56 after treatment showing 1.92% improvement (Table 04). The result found was statistically highly significant with 'p' value <0.001. This may be due to the *Medhya prabhavas* of drugs

like *B. monnieri* and *C. paniculatus* which increases grasping and intellectual ability. Past studies also supports this data. *B. monnieri*<sup>[3]</sup>, *C. pluricaulis*<sup>[4]</sup> have proven improved learning and memory enhancing activity (intellectual functions).

### Discussion on the effect of therapy

The patients were treated in a single group by administration of *Brahmi ghrita* orally and *Jyotishmati Tail* by nasal route. The results were observed and evaluated for laboratory parameters and IQ level. Effect attained in present study by the drug can be explained by multiple mechanisms of actions of its ingredients. The base used was *Ghrita* and Oil which facilitates the mode of action of drug and gives better results. The study drug "*Brahmi Ghrita*" contains 11 herbal Ayurvedic drugs and "*Jyotishmati tail*" which contain single Ayurvedic herb, *Jyotishmati*. The ingredients of above two drugs have predominantly *Tikta, Katu Rasa; Laghu, Tikshna, Ushna, Sara Guna; Rasayana, Smritiprada, Buddhiprada, Matiprada, Medhya, Deepana, Pachana, Ojovardhak, Srotoshodhak* and *Vata-Kapha Shamaka* properties and *Medhya Prabahava*.

The base of the *Ghrita* is *Deepana, Pachana, medhavardhaka*<sup>5</sup> thus it may regulate *Sadhaka* and *Alochaka pitta*. *Sukshma Guna* of *Ghrita* helps to reach the drug in micro channels so drug easily comes into systemic circulation and break the *Dosha-Dushya-Samurchchhna*. Lack of concentration, loss of memory was also improved significantly which was due to *Medhya* properties of *Ghrita*. *Shankhpushpi* and *Brahmi* are having properties like *Medhavardhana, Smritivardhana*. Here *Ghrita* is also helpful media by its *Medhya* and *Smritivardhana* properties. Therefore *Brahmi Ghrita* is capable to provide a patent, stable and healthy mental function which improves mental health. This is evident of that *Ghrita* gets absorption through cells of lining membrane and then comes in to circulation through local capillaries and veins.

*Ghrita* being *Yogavahi* can be used in other *Ayurvedic* preparations. Digestion, absorption and delivery to a target organ system are crucial in obtaining the maximum benefit from any formulation. This is facilitated by *Ghrita*. Since active ingredients are mixed with *Ghrita*, they are easily digested and absorbed. The *Ghrita* is *sheeta* in *Virya*<sup>[6]</sup> and is thus *Manahprasadaniya* and increase the *Tarpaka kapha* and *Avlambaka kapha* thus improving the *Dharana shakti*.

Lipophilic action of *Ghrita* facilitates transportation to a target organ and final delivery inside the cell, because cell membranes also contain lipid.<sup>[7]</sup> The modern lipophilic nature<sup>[7]</sup> can be compared with the *Yogavahi Guna* of *Ghrita* according to *Ayurveda*.<sup>[8]</sup> This lipophilic nature of

*Ghrita* facilitates entry of the formulation in to the cell and its delivery to the mitochondrion, microsome and nuclear membrane. In the process of evaluating the activities of natural compounds, it has been found by means of sophisticated research that when herbs are mixed with *Ghrita*, their activity and utility is potentiated many times.

*Ghrita* contains beta carotene and Vit. E and both are known antioxidants. It is estimated that 80% to 90% of degenerative disease are related to excessive production of free radicals of re-active oxygen species. When free radicals are in excess they try to catch on to whatever is available in their surrounding area and this is how the lipids in the blood and cell membrane are oxidized. The oxidized lipids or the lipid peroxides are injurious to the system. The reactive oxygen species cause damage to the DNA in the cells. The effectiveness of compounds is due to potent anti-oxidant properties of removing of scavenging free radicals.

*Jyotishmati* is known for its memory enhancing effects. The oil of *Jyotishmati* is *Ushna virya* predominant<sup>[9]</sup> and hence probably acts by dispelling the *tamas* and vitiated *Kapha* from *Hridya* and *Manovahasrotas*. It may also regulate the functions of *Alochaka* and *Sadhaka pitta*, thereby improving the *Grahana shakti* and *Smriti*. Due to its *Ushna guna* it also boosts *Pachaka pitta*. Thus the unhampered status of *Agni* takes care of nutrition of *Indriyas*. By virtue of its *Snighdha* and *Guru gunas* it corrects the vitiated *Vata* and also *Bala* to *Indriyas* and *Hridya*. The oil is administered in form of *Nasya*; also being *Sukshma*, it quickly reaches to *Mastishka* and *Buddhindriya*, thus improving the intellect.

Lying down in head lowered position, heat fomentation on the face etc. steps of *Nasya Karma* help the drug to absorb and to reach in brain which lastly results in stimulation in higher centers. So, the effect of the drugs extends up to whole neurovascular system. The absorption of the drugs administered by *Nasya Karma* is not only limited to nasal or paranasal area as the excess medicine reaching to the throat is to be spit out by the patient but also alleviate the vitiated *Dosha* regarding its potency (*Prabhava*). The postures in the procedures of *Nasyakarma* also play an important role. The act of lying down in head lowered position, fomentation and massage on the head etc. may have an impact on the neurovascular junction and drug absorption. The stimulation of olfactory nerve may affect neuroendocrinal and neuro psychological levels.

*Brahmi Ghrita* is a mixture of *Rasayana* drugs. *Medha* (intellect) and *Smriti* (Memory) are among various attributes of *Rasayana*. Most of the ingredients by their *Deepana, Pachana* properties

increase the *Agnibal* (digestion, absorption and metabolism). Thereby increase the bioavailability of various micronutrients from the food ingested leading to *Prashastha dhatu* or *Sara* (healthy tissues) and best qualities of *Smriti* and *Medha* are the attributes of various *Saras* e.g. *Twak sara* person is rich in *Buddhi*, *Rakta sara* in *Medha* etc.

All the ingredients in study drugs being *Rasayana* have antioxidant action. Adaptogenic property of *C. pleuricaulis* has been effective to provide protection to brain against a variety of biological, physical and chemical stressors.<sup>[10]</sup>

**IQ level-** The mean score before treatment was 80.06 which were increased to 81.56 after treatment showing 1.92% improvement. The result found was statistically highly significant with 'p' value <0.001. This may be due to the *Medhya prabhavas* of drugs like *B. monnieri* and *C. paniculatus* which increases grasping and intellectual ability. Past studies also supports this data. *B. monnieri*<sup>[3]</sup>, *C. pluricaulis*<sup>[11]</sup> have proven improved learning and memory enhancing activity (intellectual functions).

This is probably due to the *Smritiprada*, *Matiprada*, *Buddhiprada* properties of drug *C. paniculatus*.<sup>[9]</sup> This is due to drugs like *B. monnieri*<sup>[3]</sup>, *P. nigrum*<sup>[12]</sup>, *Z. officinalae*<sup>[13]</sup> which have proven very good effect on cognition. Oxidative stress and inability to understand and follow directions also correlated with each other. The drug *E. ribes*<sup>[14]</sup>, *P. longum*<sup>[15]</sup> showed good effect on oxidative stress.

The improvement is due to drugs like *C. paniculatus*<sup>[16]</sup>, *P. nigrum*<sup>[17]</sup> which decrease the AChE activity from hypothalamus, frontal cortex and hippocampus leading to increase cholinergic activity like learning in the brain.

This is due to effect of drug *P. longum* which increases the neuropharmacological activity.<sup>[18]</sup> This is due to the effect of drug *C. paniculata*<sup>[16]</sup>, *Z. officinalae*<sup>[19]</sup> which have proven their activity to increase learning ability and memory functions.

The drug *Brahmi Ghrita* contains *Medhya*, *Smritiprada*, *Buddhiprada* drugs like *B. monnieri*, *C. pluricaulis* which increases the short memory and long term memory and reduce the anterograde as well as retrograde amnesia.<sup>[20]</sup>

## CONCLUSION

Following conclusion can be drawn from the present research work:

Borderline Mental Retardation is a multifactorial neuropsychological disorder of childhood. Children with Borderline Mental Retardation are more likely to experience a substantial array of problems in cognitive, behavioral, social and emotional fronts.

Ayurveda holding a different view regarding the etiopathogenesis of diseases can provide newer theories of Borderline Mental Retardation and thus new dimensions to its management. Alteration in *Manoarthas*, *Manovishayas* & *Manas karmas* and degradation of *Dhee*, *Dhriti* and *Smriti* are the basic pathological events in manifestation of Borderline Mental Retardation. *Vata-kapha* trait of *Sharirika prakriti* can render a child more prone to Borderline Mental Retardation as compared to *pittaja*. *Tamo guna* of psyche can add to the severity of the symptoms of Cognitive deficit Borderline Mental Retardation.

Multimodal approach including drug, and *Prakriti* based counseling can be effectively used to manage the disease.

No adverse effects of the study drugs were observed during the study. This indicates the safety profile of the study drug. Thus it can be concluded that both drug, *Brahmi Ghrita* and *Jyotishmati Tail* were found effective in alleviating the symptoms of Borderline Mental Retardation.

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