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Research Article

FUNCTIONAL SKILL DEVELOPMENT OF THE AUTISTIC CHILDREN THROUGH DIETARY INTERVENTION

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ABSTRACT

Background: Autism is a complex pervasive developmental disorder that involves the functioning of the brain. It is emerging as the fastest growing serious developmental disability among the children. The restricted diets of the autistics produce a cascade of biochemical abnormalities which necessitates dietary intervention at the earliest to prevent long term repercussions. Nutritional therapy and dietary restrictions may be a helpful complementary treatment. ***Objective:*** The study was undertaken to assess the impact of dietary intervention on the functional skills of the autistic children (5-16 yrs). ***Methods:*** A group of 60 autistic children were selected from two centers based on the consent obtained from the parents and teachers. They were divided into 3 groups of 20 children each. Children in the experimental group I were administered daily specially developed biscuits (50g), experimental group II received the biscuits (50g) with added probiotic. Experimental group I, II and the control group received nutrition education. All the children were trained through IAP as a routine school programme, in addition to this. The impact of intervention was evaluated after a period of 6 months in terms of skill development that included 18 functional domains, namely gross motor, fine motor, eating, dressing, grooming, toileting, receptive and expressive language, social interactions, reading, writing, numeric skill, time, money, domestic behaviour, community orientation, recreation and leisure time activities and vocational orientation. ***Results:*** A significant improvement ($p<0.01$) was observed in all the functional skills in both the experimental groups at the end of the intervention. The children receiving probiotic biscuits were slightly better than those in the experimental group I who receive only biscuits in certain observations. Both the experimental groups showed a greater improvement than that of the control. ***Conclusion:*** The results of this study stress the need for dietary intervention and nutrition education to autistic children for improving their standard of living.

INTRODUCTION

Autism is a complex developmental disability characterized by impairment in communication, socialization and imagination increasing in epidemic proportion owing to neurodevelopmental abnormalities. The most recent estimate of the prevalence of autistic disorders among children is about 1% on a global scale[1]. While research into the causes and treatments for autism have abounded, there is no known single cause for autism and it currently ranks as one of the fastest-growing developmental disabilities. The onset of autism occurs during the first three years of life and has a gender bias with a ratio of 5 males to 1 female[2].

Common comorbidities associated with autism include gastrointestinal disease and gut dysbiosis, autoimmunity and mental retardation[3]. In addition to conventional therapies, many families explore the realm of alternative therapies to treat autism because they are perceived to be more natural and less invasive than conventional therapies.

Almost all autistic children have nutritional deficiencies, food intolerances or gastrointestinal disorders that are not thoroughly addressed. The goal of nutrition therapy in autism is to support the structure and function of the child's brain and body to perform at the optimal level and to maximize the child's brain function so that the response to other treatment is enhanced. With the increasing prevalence of ASD at an alarming speed, the role of food in treating the children becomes imperative. There is a need to develop special foods/ recipes using functional food ingredients and make them available in the market. Nutritional supplements significantly contribute towards their improvement of IQ, scholastic test scores and early neurological development. This study attempts

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at developing and testing suitable dietary supplements for the autistic children to enhance their quality of life.

Objective

- To develop dietary supplements for the autistic children with and without probiotics
- To evaluate the impact of feeding on the functional skills of the children.

MATERIALS AND METHODS

Development and testing the acceptability of special food supplement

Selection of ingredients

The most basic, fresh, natural and non-processed nourishment could be the best supplement for the autistic child. The challenges that are faced by the autistic children are multifold and this could be addressed by incorporating foods containing certain essential nutrients and friendly microbes. In order to accomplish this objective, recipes were developed using functional ingredients namely brown rice, flax seed, roasted Bengal gram dhal, dates syrup, honey and palm oil. Health benefits of the selected special food components are described below:

Brown rice**:** The unpolished, dehusked paddy is the brown rice, which is a rich source of dimethylglycine (DMG). Many studies have shown that inclusion of DMG in the diet of the autists produced improvement in behaviour, better eye contact, increased frustration tolerance, better response to infection, better concentration and interest in games, decreased seizures, enhanced muscle energy, reduced muscle cramping, improved speech, improved physical performance and acts as an immune modulator[4]. It acts as a detoxifier and an effective antioxidant that protects the cell from free radical reaction[5].

Flax seeds**:** Flax seeds also known as the wonder food is botanically called as *Linum usitassimum.* Flax seeds are rich in alpha linolenic acid (ALA) an omega-3 fatty acid. Autistic individuals benefit from omega-3 supplementation in terms of behaviour control and learning. EFA are also important in fighting the increased inflammatory response seen in many autistic children.

Date syrup**:** Iron deficiency in the autistic children has been associated with irritability and sleeplessness. Insomnia has been documented consistently in children with autism spectrum disorder[6].

Honey**:** Sucrose and other simple sugars are easily broken down and they elevate the blood glucose levels since the autistic children have an impaired glucose tolerance. The glycemic index of honey is less than the sugars and it was used in the place of sugar as a sweetening agent. Researchers have found that honey has various vitamins and iron in large amounts and its use strengthens the white blood corpuscles[7].

Roasted Bengal gram dhal**:** In order to improve the taste, texture and incorporate protein in the food product roasted Bengal gram dhal was used. Addition of the protein would enhance the production of enzymes and amino acids required for the metabolic processes.

Palm oil: Palm oil was used instead of butter and hydrogenated fat since it would reduce the transfat content of the biscuit.

Formulation and selection of recipes

The different food preparations namely porridge, laddu and biscuits were developed using various proportions of the above ingredients and their suitability to feed the children was studied. Of these preparations, biscuits were found to be the most suitable for supplementation based on sensory evaluation and ease of handling. The formula could not be presented since it is in the process of patenting 4517/CHE/2013

Development and evaluation of a pulse based probiotic food

Probiotic foods have diverse health benefits; certain lactic acid bacteria strains exert a positive effect on the immune system, through an induced increase in certain immunoglobulins such as serum IgA. The probiotic foods currently available in the market are either dairy based or cereal based. This study aimed at developing a probiotic mixture using pulses as a base since these children were allergic to the milk protein casein. *Lactobacillus was* used as an inoculating organism. The two pulse based probiotic foods were prepared using equal proportions of the cowpea flour and green gram flour with the addition of i) 2% commercial lactic acid bacillus or ii) 20% homemade curd. The two probiotic foods developed were further evaluated for their probiotic properties using standard procedures.

Nutrient analysis of the biscuit

The nutrients present in the biscuits were analysed using standard procedures[8].

Selection and grouping of the autistic children

Baseline data was obtained from 400 autistic children from the state of Tamil Nadu, India and sixty autistic children both boys and girls in the age group of 5 to 16 years were selected for the study. Children who were taking medications for other ailments were excluded from the study. Children who were comparable in terms of the therapies received were chosen as the subjects for the present investigation. They were divided into three groups of 20 children each and designated as experimental group I, experimental group II and the control group. Consent was obtained from the school authorities, individual parents and Human Ethical Committee of the University (HEC.2010.15) before starting the experimental study.

Dietary Intervention through supplementation

It was decided to supplement 50g of the biscuits to the experimental group I supplying 1.8 g of omega 3 fatty acids based on research reports[9] for a period of six months, which amounted to two biscuits in the forenoon and two biscuits in the afternoon. Experimental group II received the same quantity of biscuits in addition to one gram of the pulse based probiotic. The probiotic could not be added to the biscuits during preparation since the high baking temperatures would destroy the *lactobacilli* it was mixed with 1 ml of honey and smeared between the two biscuits. The biscuits were distributed to the children in the school regularly during their snack time.

Evaluation of the impact of intervention in the autistic children

The impact of intervention was studied interms of changes in the functional skills of the children assessed both initially and six months after the dietary intervention.

Functional assessment of the autistic children

The skill development of the autistic children was assessed through the Individual Educational Programme (IEP) adapted from the Madras Development Programming System (MDPS) [10] appropriately modified to suit the present study. It provides information about the functional skills of the child to facilitate individual programme planning.

The scale consists of 360 observable and measurable items grouped under 18 functional domains, namely gross motor, fine motor, eating, dressing, grooming, toileting, receptive and expressive language, social interactions, reading, writing, numeric skill, time, money, domestic behaviour, community orientation, recreation and leisure time activities and vocational orientation. Each domain lists twenty items in an increasing order of developmental difficulty and along the dependence-independence continuum. The MDPS system helps to record the challenging behaviour which can be taken care through the IEP.

The child's performance on each item was rated as 1- totally dependent, 2 - physical prompting, 3 - verbal prompting, 4 – clueing and 5 - independent, depending on whether the child can or cannot perform the target behaviour listed in an item on the scale. The initial skill assessment for every domain was done by the special educator for both the experimental groups and the control group. The skill training was given to the children routinely based on their curriculum and the final skill assessment was done after six months. All these activities were closely followed by the investigator and their performance was recorded pre and post supplementation which helped in evaluating the child's progress over a period of time.

Data analysis and interpretation of the results

The data collected were consolidated, tabulated, analysed and interpreted using statistical procedures such as t- test, f- test, Wilcoxn's Signed Rank Test.

RESULTS AND DISCUSSION

Formulation of the biscuits

Special biscuits with functional ingredients were developed using the ingredients as indicated below in Table I

Table I Composition of the Biscuits

Ingredients	Quantity	Variations	Taste ingredients	Quantity
Brown rice	Standard #	**Salt biscuits** V1	Salt	2 g
Roasted Bengal gram dhal	Standard #	**Sweet biscuits** V2	Honey	10 ml
Flax seeds	Standard #	V3	Dates	20 g
Palm oil	Standard #	V4	Dates	20 g
			Cashew	5 g
		V5	Dates syrup	10 ml
			Honey	10 ml

The amount is not indicated since it has been applied for patent

A product which was familiar to all the children and easily acceptable was identified to be biscuits and they were prepared meticulously to incorporate all the beneficial ingredients and avoid the trigger foods as listed below which are largely present in the commercial products.

- refined wheat flour – gluten is maldigested
- butter and milk / milk solids – traces of casein present is maldigested
- synthetic flavours, colours, baking soda and preservatives –aggravate the negative behaviour
- sugars – triggers their hyperactivity

Nutrient content of the biscuits

The nutrient content of the biscuit is presented in Table II.

Table II Nutrient Content of the Biscuit

Nutrients	Content per 100 g	Nutrients	Content per 100 g
Moisture (g)	3.2	Calcium (mg)	86
Fat (g)	11.4	Magnesium (mg)	103
Protein (g)	8.7	Iron (mg)	2.7
Crude fiber (g)	4.2	Zinc (mg)	1.9
Carbohydrate (g)	59.4	Copper (mg)	0.4
Sodium (mg)	66	Manganese (mg)	0.8
Potassium (mg)	429	Omega 3 fatty acid(g)	3.6

Lack of certain dietary nutrients notably, essential vitamins, minerals and omega 3 fatty acids contribute to the development of mental disorder. 100 g of the biscuits contained 3.24 g moisture, 1.66 g ash, 8.71 g protein, 4.2 g crude fiber and 59.4 g carbohydrate. The micronutrients present were sodium 66 mg, potassium 429 mg, calcium 86 mg, magnesium 103 mg, iron 2.7 mg, zinc 1.9 mg, copper 0.4 mg, manganese 0.8 mg and 3.6 g of omega 3 fatty acids.

Suitability of the pulse based probiotic food

The probiotic food was tested for resistance to bile salt, acidic pH, as well as their ability to inhibit pathogens as outlined by the joint FAO/WHO working group[11] since the bacteria must tolerate the gastrointestinal stress for their metabolic activity, and to colonise the gastrointestinal tract.

Table III Evaluation of the Pulse Probiotic

Tests applied	Parameters	Criteria	Total no. of colonies (cfu)/ g
Viability of Lactobacilli	Treatment given	2% lactic acid bacillus	47×10^{6} #
		10% home made curd	35×10^{6}
Resistance to gastric acidity	pH range	2	$33X10^{6}$
		4	$90X10^{6}$
		7	$80X10^{6}$
Bile acid resistance	Conc. of oxgall (%)	0.0	TNTC
		0.3	TNTC
		0.5	$89X10^{6}$
		1.0	$68X10^{6}$
Antimicrobial activity	Test organism	Zone of inhibition (mm in diameter)	
		Standard drug	*Lactobacillus* (Bacteriocin)
	Escherichia coli	16 ± 0.01	14 ± 0.04
	Staphylococcus aureus	12 ± 0.04	7 ± 0.02
	Candida albicans	14 ± 0.02	8 ± 0.03

Chosen for further evaluation

The total number of colonies in the 2 per cent commercial lactic acid bacillus treated pulse flour was $47X10^6$ cfu/g and the number of colonies were lesser ($35X10^6$ cfu/g) in the 20 per cent curd treated pulse flour. Hence the use of commercial lactic acid bacillus was preferred for further evaluation.

The viability of the *Lactobacilli* at neutral pH was $80X10^6$ cfu, which increased to $90X10^6$ cfu at a pH of 4. Even at a pH of 2, the count was $33X10^6$ cfu indicating that the *Lactobacilli* would resist the acidic environment of the stomach.

At the bile acid concentrations of 0.0 and 0.3 per cent, the colonies were too numerous to count, at 0.5 per cent level there were $89X10^6$ cfu and at 1.0 per cent level there were $68X10^6$ cfu, indicating that the *Lactobacilli* was viable even at a high bile acid concentration.

The zone of inhibition was greater for *E. coli* and it is comparable to that of the standard antibiotic streptomycin. The zone of inhibition produced by the *Lactobacilli* against *Staphylococcus aureus* was 7±0.02 as compared to the standard antibiotic, which was 12±40.4. The zone of inhibition using *Lactobacilli* against *Candida albicans* was 8±0.03 and it was 14±0.02 for the standard drug amphoterecin B, which revealed that the probiotic mixture had considerable antimicrobial activity.

Impact of intervention on the Functional skills of the autistic children

The assessment was made before and after the intervention period of six months. The individual score obtained for each activity by the autistic child was recorded and the mean scores obtained for each skill was computed. The initial and final scores received by the experimental groups I, II and the control group was computed based on their individual performance. The difference in the initial and final scores was determined for each group of the autistic children separately and collectively. Their level of significance was tested using Wilcoxn Signed Rank Test. Within group and between groups comparison was made and the results obtained are presented in this section.

Motor skills

The ability to physically navigate the world requires considerable skill that stems from the central nervous system. The skills include large movements, or gross motor skills and small movements, known as fine motor skills.

The Wilcoxn signed rank score obtained by the autistic children for motor skills are presented in the Table IV

Gross motor

Many autistic children do not develop a normal sense of themselves in relation to their environment. They lack awareness of where their bodies are in relation to their surroundings. However, many autistic individuals demonstrated superior gross motor skills and balance. Gross motor skills improved significantly ($p<0.01$) in the experimental groups I and II over that of the control group. However the inter group variation among two experiment groups were not significant.

Fine motor

Fine motor activities showed a significant difference when the control group and the experimental group I and II were compared. Though the inter group variation was not significant. Acquiring these skills takes a longer time since the autistic children don't lend themselves completely owing to their behaviour characteristics

Activities of daily living

Learning to perform activities of daily living, like dressing, self-feeding and toileting is crucial to a person's independence and their ability to take part in the larger world. Mastering such tasks can be especially challenging for those on the autism spectrum. The Wilcoxn signed rank score obtained by the autistic children for activities of daily living are given in the following TableV

Meal time activities

With abnormal food behaviours and food selectivity the meal time activities were an area of concern in these children. Significant difference ($p<0.01$) was observed between the control group and the experimental groups I and II. The degree of improvement in the experimental groups over and above that of the control group could be attributed to the consumption of supplementary foods with beneficial nutrients such as ω- 3 - fatty acids and dimethylglycine.

Dressing and Grooming skills

Grooming in the autistic children is usually carried out with the help of the parents or the care takers.

Table IV Wilcoxn Signed Rank Scores For The Motor Skills

Motor skills	Group I vs. Control			Group II vs. Control			Group I vs. Group II		
	Initial	Final	Difference	Initial	Final	Difference	Initial	Final	Difference
Gross motor	0.979 NS	3.471**	3.497**	0.711 NS	3.491**	3.458**	0.743 NS	0.577 NS	1.000 NS
Fine motor	0.499 NS	3.535**	3.448**	0.372 NS	2.982**	2.829**	0.333 NS	1.897 NS	1.508 NS

* Significant at five per cent level; ** Significant at one per cent level; NS Not significant.

Table V Wilcoxn Signed Rank Scores for the Activities of Daily Living

Daily living skills	Group I vs. Control			Group II vs. Control			Group I vs. Group II		
	Initial	Final	Difference	Initial	Final	Difference	Initial	Final	Difference
Meal time activities	0.722 NS	3.284**	3.040**	0.000 NS	3.337**	3.542**	0.812 NS	0.632 NS	0.365 NS
Dressing	0.000 NS	3.494**	3.220**	0.000 NS	3.877**	3.700**	0.000 NS	1.633 NS	1.265 NS
Grooming	2.000*	3.758**	3.578**	0.378 NS	3.703**	3.678**	1.134 NS	2.000*	2.333*
Toileting	0.577 NS	3.817**	3.696**	0.333 NS	3.987**	3.841**	0.905 NS	1.414 NS	0.187 NS

* Significant at five per cent level; ** Significant at one per cent level; NS Not significant.

When the children belonging to the experimental groups I and II were compared with that of the control group there was a significant improvement ($p<0.01$). But the inter- experimental group difference was not marked indicating that both the supplementary foods were equally effective.

Toileting

Toileting skills are usually established in normal children by the age of five yrs. However acquiring these skills in the autistic children is difficult. The children belonging to the experimental group I and II recorded a significant improvement over the control group ($p<0.01$). One of the major hurdles in training the toileting habits for the children is their inability to communicate their needs.

Language skills

One of the classical features of the autistic child is the impairment in communication. Table VI presents the receptive and expressive language skills of the autistic children.

Social interaction and community orientation

Interaction with the society becomes inevitable for all the human beings and it implies for the autistic individuals as well. When the children belonging to the experimental groups I, II and the control were compared with each other for their social interaction and community orientation, the improvement in the experimental groups I as well as II were found to be significantly greater ($p<0.01$) than that of the control group. Significant difference was not recorded between the experimental group I and II.

Academic skills

Accomplishing academic skills in the autistic children is difficult because it is a cognitive process. The Wilcoxn signed rank scores for the academic skills of the autistic children is depicted in Table VIII

Table VI Wilcoxn Signed Rank Scores For The Language Skills

Language skills	Group I vs. Control			Group II vs. Control			Group I vs. Group II		
	Initial	Final	Difference	Initial	Final	Difference	Initial	Final	Difference
Receptive language	1.000 NS	3.835**	3.987**	1.000 NS	3.624**	3.640**	0.000 NS	0.707 NS	0.462 NS
Expressive language	0.292 NS	3.901**	3.963**	0.879 NS	3.516**	4.119**	1.841 NS	0.707 NS	1.633 NS

* Significant at five per cent level; ** Significant at one per cent level; NS Not significant.

Receptive language and Expressive language

One of the classical features of the autistic child is their impairment in communication. The comprehension of the children to carry out a task largely depends upon their receptive skills. The children belonging to the experimental groups I and II were compared with the control group and it was found that their receptive language and expressive language skills showed a greater significance ($p<0.01$). The inter experimental group variation was minimum and therefore was not significant.

Social skills

Social interaction skills are rudimentary in the autistic children. The major area of concern in the development of the autistic children is their social skills. The Wilcoxn signed rank scores obtained by the autistic children for their social skills are presented in the Table VII.

Reading skill

Teaching autistic children reading skills can be a daunting task. When the autistic children were assessed for computational purpose, the difference between the experimental groups I and II were found to be significantly greater than the control group ($p<0.01$). They exhibited an improvement in their comprehension which was encouraging. The difference between the two experimental groups was not significant since both the groups receive the beneficial nutrients.

Writing skills

With neuromuscular in coordination and deficit fine motor skills writing was a challenging task for the autistic children. The children belonging to the experimental groups I and II

Table VII Wilcoxn Signed Rank Scores for the Social Skills

Social skills	Group I vs. Control			Group II vs. Control			Group I vs. Group II		
	Initial	Final	Difference	Initial	Final	Difference	Initial	Final	Difference
Social interaction	0.000 NS	3.475**	3.816**	2.233*	2.368*	3.731**	1.983*	1.403 NS	0.000 NS
Community orientation	0.513 NS	3.720**	3.574**	1.414 NS	3.714**	4.028**	0.707 NS	0.000 NS	0.520 NS

* Significant at five per cent level; ** Significant at one per cent level; NS Not significant.

Table VIII Wilcoxn Signed Rank Scores For Academic Skills

Academic skills	Group I vs. Control			Group II vs. Control			Group I vs. Group II		
	Initial	Final	Difference	Initial	Final	Difference	Initial	Final	Difference
Reading skill	0.889 NS	3.336**	3.710**	0.289 NS	3.552**	3.862**	0.756 NS	0.577 NS	1.941 NS
Writing skills	1.633 NS	3.923**	3.825**	1.732 NS	4.018**	3.976**	1.633 NS	1.667 NS	2.179*

* Significant at five per cent level; ** Significant at one per cent level; NS Not significant.

recorded a highly significant improvement ($p<0.01$) over that of the control group. The results indicate that fine motor skills could be accomplished to a considerable extent when the autistic children are given an early intervention along with suitable food based approach.

Vocational skills

In order to ensure an independent and descent living in the adulthood the autistic children are provided appropriate vocational training. The Wilcoxn signed rank scores obtained by the autistic children for their vocational skills are presented in Table IX

Handling money and occupational skills

The concept of the value of money and handling the money were inculcated to the children based upon their level of comprehension.

Time concept

Time is an abstract concept and training the autistic children in this area was challenging. When the experimental groups I and II was compared with the control group it was found to be highly significant ($p<0.01$), though the scores recorded by the experimental groups I and II was non-significant.

Domestic skills

Autistic children were trained in the domestic activities with a motive to make them self sufficient. The Wilcoxn signed rank score obtained by the autistic children for domestic skills are presented in Table XI.

Domestic activities

Basic household activities were fixed as the target for the autistic children and their ability to accomplish them was evaluated.

Table IX Wilcoxn Signed Rank Scores For The Vocational Skills

Vocational skills	Group I vs. Control			Group II vs. Control			Group I vs. Group II		
	Initial	Final	Difference	Initial	Final	Difference	Initial	Final	Difference
Handling money	0.447 ^{NS}	3.921**	3.888**	1.633 ^{NS}	3.714**	4.008**	1.342 ^{NS}	1.414 ^{NS}	0.447 ^{NS}
Vocational skills	0.000 ^{NS}	3.827**	3.463**	0.577 ^{NS}	3.578**	3.704**	0.447 ^{NS}	0.707 ^{NS}	0.250 ^{NS}

* Significant at five per cent level; ** Significant at one per cent level; ^{NS} Not significant.

When all the children belonging to the experimental groups I and II were compared with the control group, experimental groups I and II scored significantly greater ($p<0.01$) than the control group subjects and the difference between the experimental groups I and II was non-significant.

Numeric skills

Number based activities were evaluated for the autistic children pre and post supplementation. The Wilcoxn signed rank scores for the numeric skills of the autistic children is depicted in Table X.

When the children belonging to the experimental groups I and II were compared with the control group, the progress was found to be highly significant ($p<0.01$), but difference observed between the experimental groups I and II was non- significant.

Recreation activities

The recreational activities of the autistic children are either based on the liking of the children or it is a learned behaviour. Free time is not always a fun time for people with autism. Giving them the power to choose their own leisure activities during free time can boost their enjoyment and improve

Table X Wilcoxn Signed Rank Scores For The Numeric Skills

Numeric skills	Group I vs. Control			Group II vs. Control			Group I vs. Group II		
	Initial	Final	Difference	Initial	Final	Difference	Initial	Final	Difference
Number concept	0.477 ^{NS}	3.945**	3.704**	0.378 ^{NS}	4.001**	3.947**	0.000 ^{NS}	0.816 ^{NS}	0.535 ^{NS}
Time concept	1.000 ^{NS}	4.008**	4.056**	0.000 ^{NS}	4.028**	4.072**	1.414 ^{NS}	2.828**	2.449*

* Significant at five per cent level; ** Significant at one per cent level; ^{NS} Not significant.

Number concept

Number based activities of the two groups of experimental children were observed pre and post dietary supplementation and it was observed to be significantly higher ($p<0.01$) than that of control group children. However, the difference between the experimental groups I and II was not significant indicating that both the supplementary foods were equally effective.

communication and social skills. When all the children belonging to the experimental groups I, II and control were compared, experimental groups I and II had recorded a significant improvement than the control group and the difference between the two experimental groups was not found to be significant. Figure 1 depicts the findings of the entire study.

Table XI Wilcoxn Signed Rank Scores for The Domestic Skills

Domestic skills	Group I vs. Control			Group II vs. Control			Group I vs. Group II		
	Initial	Final	Difference	Initial	Final	Difference	Initial	Final	Difference
Domestic activities	1.000 ^{NS}	3.789**	4.064**	0.707 ^{NS}	3.804**	4.005**	1.518 ^{NS}	0.000 ^{NS}	1.291 ^{NS}
Recreation activities	0.000 ^{NS}	3.419**	3.419**	1.000 ^{NS}	3.464**	3.300**	1.000 ^{NS}	1.342 ^{NS}	0.577 ^{NS}

* Significant at five per cent level; ** Significant at one per cent level; ^{NS} Not Significant.

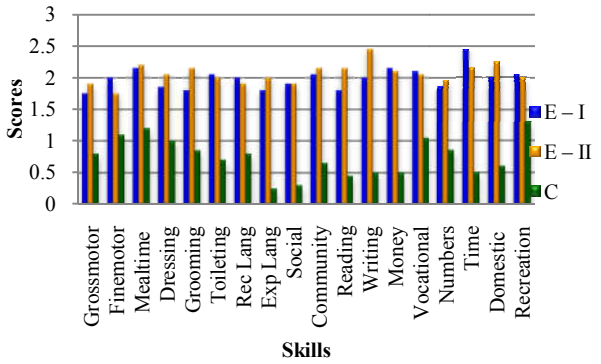

Figure 1 Incremental functional skill development in the autistic children

SUMMARY AND CONCLUSION

The functional skills of the autistic child with respect to the motor skills, activities of daily living, language skills, social skills, academic skills, vocational skills, numeric skills and domestic skills showed improvement in the experimental groups I and II over that of the control group. The improvement in the skills could be attributed to the regular intake of the supplementary foods containing autism friendly nutrients. The biscuits which were allergen free and additive free were liked by the children and the parents. The pulse based probiotic was equally good, however its storage and usage has to be done with caution to avoid contamination. The parents expressed their concern about the non availability of such alternative foods in the market and wished that many such foods should be developed in the future for the benefit of the autistic children. They were satisfied about the gradual improvement in the functional skills of their child.

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