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Research Article

Role of Environmental Enrichment on the Motor Proficiency of Institutionalized and Non-Institutionalized Children - An Experimental Study

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A B S T R A C T

Introduction: Environmental influences play an important part for the development of motor skills in children.

Aim: The current study assessed the impact of environmental influences on motor proficiency among children in Institutionalized (IN) and Non-Institutionalized (NI) residences.

Methods and Materials: This experimental study was carried out in orphanages and schools, among children of 4-8 years for a period of one year. There was total 32 children, and each group consisted of 16 children. Bruininks- Oseretsky Test (BOT-2) was used to asses Motor proficiency. Association among the groups was assessed using the independent t-test, with $p<0.05$ seen as statistically significant.

Results: Significant improvements were observed in various motor skills in both institutionalised and non-institutionalised groups following the intervention. Among institutionalized, ($p= 0.008$) Fine Motor Precision, ($p=0.0001$) Fine Motor Integration, ($p=0.002$) Manual dexterity, ($p= 0.01$) Upper limb coordination, ($p=0.0001$) Bilateral coordination, ($p< 0.0001$) Strength, ($p< 0.0001$) Total motor composite and Running speed and ($p< 0.0001$) Agility were considered significant. For NI, Fine Motor Integration($p=0.0001$), Manual dexterity ($p=0.02$), Upper limb coordination ($p= 0.003$), Bilateral coordination ($p=0.003/0.001$), Total motor composite ($p< 0.001$) and Balance ($p= 0.03$) were proved to be statistically significant. When pre and post intervention difference was compared between the groups, Balance ($p= 0.03$), Strength ($p< 0.0001$) and Total motor composite ($p= 0.03$) were found to be significant.

Conclusion: The present study observed that there was an evident difference in. the motor proficiency of IN and NI children and hence it is imperative that the care takers in the institutions contribute towards enriching the motor proficiency at a younger age.

Keywords: Institutionalized Children, Orphanages, non-institutionalized Children, Schools, Motor Proficiency, BOT-2 MP, Environmental Enrichment, Tailor-made Intervention

Introduction

Mastery of children's motor proficiency is influenced by family and home environments.[1,2] Institutionalized children, particularly orphans, often experience impaired bilateral coordination and development due to poor environments, though some remain resilient.[3,4] The National Family Health Survey-3 reports 17.3% of Indian children and 15.3% in Karnataka are orphans.[5] Enhanced early-life movements and stimuli improve motor skills, crucial for intellectual and social development.[6-8] The Bruininks- oseretsky Test of Motor Proficiency Second Edition (BOT-2) effectively assesses the motor deficits.[9-12] Environmental enrichment (EE) enhances cognitive, motor, and sensory development. This study evaluates environmental impacts on motor proficiency in children aged 4-8 from institutionalized and non-institutionalized backgrounds.[13-15]

Methods

This one-year experimental study was conducted among 4–8-year-old children in orphanages and age-matched controls from schools in Belagavi, Southern India. The sample size consisted of 32 children, with 16 in each group. The sample size was calculated using N = 2*(Z1-β + Z1-α/2) ^2/d^2, where Z1-α/2 = 1.96 for a 5% significance level, Z1-β = 0.84 for 80% power, and 'd' is the effect size. A non-probability sampling design and randomized control sampling technique were used.

Children enrolled and raised in Belagavi orphanages, regardless of gender, were included. Exclusion criteria were significant head injury, gross neurological deficits, epilepsy, or serious medical conditions. Ethical clearance was acquired from the Institutional Ethics Committee, and permission was granted by the heads of orphanages, parents, and school authorities. Informed consent was obtained in writing from carers and parents. Age, gender, and Body Mass Index (BMI) were collected.

Bruininks- Oseretsky Test of Motor Proficiency (BOT-2), evaluates fine and gross motor skills across four motor area composites with eight subsets comprising 53 items: Fine Motor Precision (FMP), Fine Motor Integration (FMI), Manual Dexterity (MD), Upper Limb Coordination (ULC), Bilateral Coordination (BC), Balance(B), Running Speed and Agility (RSA), and Strength(S). The total score was 320 with a test-retest reliability of 0.83.[9]

Children in orphanages were screened by a physician and assessed using BOT-2. A tailored intervention (Table 1) was administered for 60 minutes, twice a week for 12 weeks. Caretakers were trained to continue the intervention four days a week and maintained a journal to document findings. Motor proficiency was reassessed after 12 weeks using BOT-2.

Children in schools were screened using the BOT-2 Short Form and those meeting the selection criteria were assessed with the complete BOT-2. Parents and guardians of the control group were counselled on environmental influences to enhance motor proficiency. Motor proficiency was reassessed after 12 weeks.

Data analysis was performed using Ri386.3.5.1 statistical software. Associations between categorical variables were calculated using the Chi-square test. Intergroup comparisons were analyzed by independent t-test, and intra-group comparisons were done by paired t-test. Statistical significance was set top<0.05.

Results

The current study included 32 children between 4-8 years. The mean age of all the study subjects was 6.43 ± 1.83 years. The Mann Whitney-U test was applied and it was observed that the median age was not significant between the groups (p= 0.5428). Using chi-square test, the gender differentiation was statistically significant (p=0.0325). The mean BMI was insignificant by t-test (p=0.2599). (Table-2)

All the variables of institutionalized group were significant (p<0.05) when pre and post intervention were compared except Balance (p= 0.3), which was insignificant. While comparing the pre-interventional variables for the non-institutionalized group, strength (p= 0.02) and total motor composite (p= 0.003) were found to be significant and fine motor precision (p= 0.1) and strength (p= 0.07) were insignificant. When pre and post intervention differences were compared between the groups, Balance (p= 0.03), Strength (p< 0.0001) and total motor composite (p= 0.03) were observed to be significant (Table-3). Fine motor integration, manual dexterity, upper limb coordination, balance, bilateral coordination, running speed and agility and total motor composite scores were not significantly different from pre scores by t-test (p> 0.05). Moreover, strength (p= 0.011) and motor composite (p= 0.036) mean after the intervention was significantly different between the two groups.

Table 1.Environmental Enrichment (EE) Program for Institutionalized group

Components	Activities
Fine Motor Precision	Picking up cubes using a pincer grasp, buttoning and unbuttoning buttons, grasping various types of paper from a flat surface and picking up objects of different shapes
Fine Manual Integration	Placing peg in a peg board, removing lids from jars, stringing and lacing activities and folding paper

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Manual Dexterity	Threading beads, moving pennies to a piggy bank, playing table tennis
Upper Limb Co-ordination	Bouncing a tennis ball on the ground with one hand, with alternate hands
Bilateral Co-ordination	Use utensil such as bubble making, hitting target on a wall, kicking a ball
Balance	Standing on one leg with eyes open and closed, standing on balance beam, standing on toes and heel, backward walking, waking on a straight line, passing through obstacles
Running Speed & Agility	Running, Skipping, Hopping, jumping jacks, lateral jumps
Strength	Wall pushups, Sit ups, Forward and Backward jumps, Wheelbarrow walking,

Table 2.Demographic data

Characteristics		IN Group	NI Group
Age (in years)		6.63 ± 1.34	6.31 ± 1.61
Gender	Male	6 (37.5%)	12 (75%)
	Female	10 (62.5%)	4 (25%)
Mean BMI (Kg/m^2)		16.81 ± 3.10	15.57 ± 3.03
BMI category	Abnormal	13 (81.25%)	14 (87.5%)
	Normal	3 (18.75%)	2 (12.5%

Table 3.Bruininks-0seretsky motor proficiency (BOT-2) test for Institutionalised and Non-Institutionalised Groups

Factors		IN Group	NI Group	p-value
		Mean ± SD	Mean ± SD	
Fine Motor Precision (FMP)	Pre	25.2±8.26	27.4±6.90	0.4
	Post	28.6±6.15	29.1±5.68	0.8
	p-value[1]	0.008*[0]	0.1	-
Fine Manual Integration (FMI)	Pre	15.1±7.71	16±9.84	0.8
	Post	26.8±6.96	27.4±6.88	0.8
	p-value[1]	<0.0001*[0]	<0.0001*[0]	-
Manual Dexterity (MD)	Pre	23.4±7.22	22±5.60	0.6
	Post	27.5±5.60	24.9±4.85	0.2
	p- value[1]	0.002*[0]	0.02*[0]	-
Upper Limb Co-ordination (ULC)	Pre	19.9±6.81	18.9±12.93	0.8
	Post	23.2±5.90	24.5±9.24	0.6
	p- value[1]	0.01*[0]	0.003*[0]	-
Bilateral Coordination (BC)	Pre	16.1±4.99	16.4±4.43	0.9
	Post	19.1±3.59	20.7±5.51	0.3
	p- value[1]	<0.0001*[0]	0.003/0.001*[0]	-

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Balance (B)	Pre	22.6±6.72	27.2±5.75	0.051
	Post	23.9±5.23	24.4±6.03	0.8
	p- value[1]	0.3	0.03* [0]	-
Running Speed & Agility (RSA)	Pre	9.81±4.48	12.94±5.80	0.1
	Post	16.8±4.64	17±3.71	0.9
	p-value[1]	<0.0001* [0]	0.005* [0]	-
Strength (S)	Pre	11.6 ± 6.72	16.6 ± 6	0.02* [0]
	Post	20.0 ± 4.58	18.8 ± 5.59	0.5
	p- value[1]	<0.0001* [0]	0.07	-
Total Motor Composite (TMC)	Pre	38.1±8.26	49.6±13.07	0.003* [0]

[0] one tailed test; p- value [(1)] indicates the p-value for within group comparison, *p<0.05 considered significant

Discussion

Motor proficiency plays an important role in the psychological, social, and physical development of children.[16] Research indicates a positive correlation between physical activities and motor development, with motor proficiency impacting cardiopulmonary activity.[17-19] Diagnosing motor developmental delays in children involves assessing age-appropriate motor development, gait, functional features, and systemic health through physical examination and electro diagnostics.[20] A five-week Children's Health Activity Motor Program (CHAMP) therapy demonstrated significant improvements in the physical activity of preschool children post-intervention, highlighting the influence of environmental factors on motor skills.[21] The Bruininks-0seretsky Test of Motor Proficiency (BOT-2) is a widely used tool for diagnosing psychometrics in children aged 4 - 21 years, commonly used in physiotherapy, pediatrics, and physical education.[22]

This study aimed to assess the motor skills of children aged 4-8 years from institutionalized (IN) and non-institutionalized (NI) backgrounds. The study measured various motor skills, including fine motor precision (FMP), fine motor integration (FMI), manual dexterity (MD), upper limb coordination (ULC), running speed and agility (RSA), total motor composite (TMC), bilateral coordination (BC), and strength tests. In the institutionalized group, all tests except the balance test showed significant improvement post-intervention. In the non-institutionalized group, all tests except FMP and strength tests showed significant improvement post-intervention. When comparing pre- and post-intervention differences between the two groups, balance, strength tests, and TMC were found to be significant.

Previous research has established a strong relation between motor proficiency and physical activity, recommending evaluating the influence of family environment on physical activity.[23] Clinical research suggests early evaluation of motor proficiency to detect motor deficits that may manifest later in childhood or early adulthood.[24] A Japanese study emphasised the merits of the home environment and its influence on gross and fine motor skills, noting the importance of guardian supervision in a child's motor development.[25,26]

Motor proficiency tests are beneficial for integrating motor skills, improving body image, activity and orientation, body control, social communication, health growth, spatial awareness, and modulation skills.[27] This study found higher balance test results compared to Robber et al.'s study for both adopted and non-adopted children.[3] Yilmaz et al. reported lower balance scores for non-active children and higher scores for those in gymnastics, aligning with this study's post-intervention analysis.[28] Cak et al. found lower balance test results for children with ADHD compared to this study.[29]

In terms of bilateral coordination, this study's findings post-intervention were consistent with Robber et al.'s study.[3] Heydari et al. reported similar upper limb agility and speed-related parameters but higher values for upper limb coordination in certain groups compared to this study.[27] Yilmaz et al. found lower upper limb coordination results in non-active children and higher results in gymnastics participants compared to this study.[28]

Strength test results from Yilmaz et al. were higher for non-active children and lower for gymnastics participants compared to this study.[28] Milne et al. reported higher values for strength and agility than this study. Fine Motor Precision (FMP) scores from Milne et al. were higher than this study's mean values but lower than Jirovec et al.'s study for boys and girls. Manual dexterity scores from this study were higher than Jirovec et al.'s for boys and girls but lower than Milne et al.'s total point scores. Running Speed and Agility (RSA) scores from this study were higher than

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Jirovec et al.'s for boys and girls but lower than Milne et al.'s total point scores.[22,24,30]

This pioneering case-control study gives new perspective regarding the role played by external stimulation on motor proficiency of children aged 4-8 years in shelter homes. It highlights the importance of environmental enrichment in improving motor skills. Future studies should focus on other factors such as caregiver's educational status, quality of food, and hygiene in institutions to provide a comprehensive understanding. Collaborations with government and private organisations to implement and train care providers could be beneficial.

Conclusion

The current study observed a compelling difference in the motor proficiency of IN children and NI children. Hence a proactive involvement of the care providers towards the motor development of children in shelters is mandated.

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