CUREON Perspective Across Modern Medicine | Open Access

Original Article | Volume 02 Issue 01 (2026) | Page No. 35-43

Associations Between Human Figure Drawing Performance and Developmental Milestones in Children Aged 4–7

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Received: June 11, 2025

Accepted: Sept 27, 2025

Published: Jan 8,2025

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Abstract

Objective:
Human Figure Drawing (HFD) has one of the most recognized test for personality. Though its focus has now been changed from projective personality inference toward developmental and neuropsychological perspectives. Current literature suggests that use of HFD might reflect underlying motor and cognitive maturation in children. However, empirical findings remain unexplored. Thus the aim of our study was to check the association between HFD and Developmental milestones in children

Material and Methods:
A cross sectional study design was employed. In order to assess the figures, a modified coding system was used related to structural complexity, visuomotor execution, and representational accuracy. Age dependants motor and cognitive measures were used to evaluate the developmental milestones. Age stratification grouping to analyze developmental stage.

Results:
There had been a significant association between HFD and DM across age strata. Stronger relationships were observed in older age groups, specifically for drawing features reflecting fine motor coordination and visuospatial organization. Age-stratified analyses also revealed non-uniform patterns of link, indicating that developmental stage moderated the further strengthen relationships between drawing performance and milestone measures.

Conclusion:
Results suggested that quantitatively coded human figure drawings are associated with motor and cognitive developmental milestones in children aged 4–7 years. Though variations were seen across

developmental stages. HFD mught be a useful adjunctive indicator of developmental progression when applied with objective scoring and age-appropriate interpretation, but should not be used as a sole diagnostic tool.

Keywords: *Human Figure Draw test, Psychology, Diagnostic tool, Neurodevelopment, Milestones, Cognition*.

Introduction

Early childhood is one of the critical period in terms of rapid neurodevelopment. In this phase, all motor coordination, visuospatial integration, and cognitive planning abilities emerge and thrive in parallel[1-5]. Though there are tests available that are gold standard but those tests can be time-intensive, resource-dependent, and occasionally limited by multiple factors[6]. Human Figure Drawing (HFD) has been a part of child assessment for long time[7]. Initially it was conceptualized as a projective technique which is used to reveal personality traits or emotional conflicts, HFD has undergone massive theoretical and methodological reassessment over the past several years[8]. Although the use of HFD as a diagnostic tool has not been established yet is shows the development of milestones effectively[9]. Literature in developmental psychology has shown that the child's abilty to make visibly recognized drawing is improved by age increment [10]. The drawings of children in pre schooling system are not as good or notable as of a child in higher classes[11]. Despite of this, There is no data available regarding testing of HFD against the milestones of kids [12]. Previous studies have mostly relied on the global or subjective interpretations of drawings, limiting it's reliability acontributing to inconsistent conclusions. Furthermore, few investigations conflated emotional or personality inference with developmental assessment, further limiting the specific developmental construction reflected in drawing tasks[13]. More recent approaches have now been focused to fill that gap area like quantitative coding systems in which discrete drawing elements like inclusion of body part, spatial organization, proportional accuracy and motor execution are scored systematically[14]. The analyses done quantitatively have showen associations of cognitive abilities and general maturation[15,16]. Many research papers have also examined the age ranges more broadly without strata which has masked the age-specific relationship requirement between drawing performance and developmental milestones[17-20]. Therefore, the present study aims to examine the associations between human figure drawing performance and motor and cognitive developmental milestones in children aged 4–7 years, using a modified quantitative coding system and an age-stratified analytical design.

Methods

It was a cross-sectional, age-stratified analytical design to examine associations between human figure drawing performance and motor and cognitive developmental milestones in the children of age range 4–7 years. Children were taken through snow ball sampling who lives in Karachi,

Pakistan only. Karachi had been selected as the study setting due to its demographic diversity and accessibility to both educational and clinical pediatric populations. Participants were needed to be enrolled in any educational setting and were needed to follow simple verbal instructions. Children with any previously diagnosed neurodevelopmental disorders, intellectual disability, visual or motor impairments affecting drawing ability were not included. Also of any known neurological conditions or current psychiatric diagnoses were also excluded. Children who were receiving the occupational therapy, physiotherapy, or cognitive rehabilitation were also excluded to minimize intervention-related confounding. Participants were taken from preschools and primary schools and pediatric OPDs in Karachi. Informed consent were taken from parents or legal guardians. The stratification of age was achieved by dividing the subjects in the groups of four: 4, 5, 6, and 7 years to check the analysis solely based on specificity of age. Sample size was calculated using rao software. Data collection procedure started after approval and consent from parents and children were kept in a familiar environment to reduce the anxiety and performance bias. Children followed the instructions and drew human figure on a blank sheet of paper without any time restriction. Drawings had been scored using a modified quantitative coding system focusing on objectively observable features, including presence and accuracy of body parts, how prpotional they were, what was the spatial organization and how they used fine motor control. Two independent raters checked this coding protocol scored all drawings.Inter rate reliability was 0.80. Motor and cognitive tools checked fine motor coordination along with problem-solving and age-expected cognitive abilities. Data were analyzed using statistical software SPSS 26. Descriptive statistics were calculated for demographic variables and outcome measures. Normality of continuous variables was assessed using the Shapiro–Wilk test. For the normally distributed data, parametric tests used were Pearson correlation and one-way analysis of variance were applied. For non-normally distributed data, non-parametric alternatives such as Spearman's rank correlation and Kruskal–Wallis tests were used. Age-stratified analyses were performed to examine developmental stage–specific associations. A p-value of less than 0.05 was considered statistically significant for all analyses.

Results

Table 1 shows the demographic data of the population taken, Average age was 5.5 ± 1.1. All participants of different ages were taken equaly. There were more male than female in terms of gender.

Table:1 *Demographic Characteristics of study sample*

Variable	n (%) / Mean ± SD

Age (years)	5.5 ± 1.1
4 years	24 (25.0%)
5 years	24 (25.0%)
6 years	24 (25.0%)
7 years	24 (25.0%)
Gender	
Male	50 (52.1%)
Infant weight (kg), mean ± SD	6.2 ± 0.9

Table 2 shows the mean scores of HFD drawing. Among 4 age groups, HFD score of 7 years was the highest. Descriptive analysis demonstrated a progressive increase in human figure drawing scores, motor milestone scores, and cognitive milestone scores with advancing age.

Table 2: *Mean Scores of Human Figure Drawing and Developmental Measures by Age Group*

Age Group	HFD Score (Mean ± SD)	Motor Milestones Score (Mean ± SD)	Cognitive Milestones Score (Mean ± SD)
4 years	18.4 ± 4.2	42.1 ± 6.5	45.3 ± 5.9
5 years	24.7 ± 5.1	49.8 ± 5.8	52.6 ± 6.1
6 years	31.9 ± 4.8	56.4 ± 4.9	59.2 ± 5.4
7 years	36.8 ± 4.3	61.7 ± 4.2	64.5 ± 4.6

In table 3, Positive association between the HFD and Motor and cognitive development tool has been noticed across all age groups. Associations have been seen more strongly in higher age groups.

Table:3 *Correlation Between HFD Performance and Developmental Milestones*

Age Group	Motor Milestones (r)	p-value	Cognitive Milestones (r)
4 years	0.41	0.041	0.36

5 years	0.53	0.009	0.49
6 years	0.62	0.002	0.58
7 years	0.68	<0.001	0.64

Discussion

This research paper showed a significant positive correlations across age strata for the association of HFD and developmental milestones. Many developmental theories and empirical findings support the notion that children's drawings evolves as they age along with underlying motor and cognitive maturation[13,21-23]. Previous papers indicates that as children progress through defined stages of drawing development, their skills in all fields increase as well reflecting their proper cognitive–motor integration rather than any physical or artistic preference[24]. As Medin DL observed, children's human figure drawings had been advancing visibly through recognizable stages like from rudimentary "tadpole" figures to more structured representations[25]. Our findings are in line with classical and contemporary developmental models. Kellogg's foundational work on fine motor development demonstrated that children's drawings become progressively sophisticated between ages 4 and 7 as fine motor control improves and symbolic representation becomes more stable as mentioned in Danilo's paper[26]. The current results confirms empirical basis by proving that associations between HFD and developmental milestones are not consistent across age but improves with age. This pattern is in line with broader evidence that, in the early childhood, the increment of integration of motor and perception coordination helps in more detailed and structured drawings[27]. It has also been found that some of the papers used HFD as a nonverbal proxy for checking intelligence generally[28]. Importantly, Current use of modified quantitative coding and age-stratified analyses increases the validity ecologically relative to previously used subjective scoring systems[29]. By using more discrete drawing features and linking them to independently checked motor and cognitive milestones, the results do support a developmental interpretation of HFD performance that is statistically grounded and age-sensitive. This also aligns with the contemporary perspectives that argues for tasks of drawing as nonthreatening, easily applied adjuncts in developmental evaluation rather than as standalone diagnostic instruments[30]. There are few limitations that needs to be mentioned as well. The design which is cross sectional limits the casual inference that's why longitudinal studies are required to meet this merit. Secondly, environmal factors such as exposure to draw a good drawing, cutlrual differences and experiences were not assessed that can limit the drawing behaviour suggesting that generalization across diverse populations should be cautious. As in summary, our results add to a growing developmental literature benefiting the future studies by showing that quantitatively coded human figure drawing performance is notably linked with age-expected motor and cognitive developmental milestones in early childhood. These links strengthen with age and provide a nuanced understanding of drawing behavior as reflective of integrated developmental progress.

Conclusion

The findings of this study revealed that the results of this research could be used as a tool to assess developmental milestones of children and to facilitate the overall assessment. The application of this tool could be used as an alternative to developmental projection. It is important to note that this tool should be used as an adjunct to standardized developmental assessments.

Author Contributions:

Ms Aqsa Arif verifies the full access to all of the data in the study and takes responsibility for the integrity of the data and the accuracy of the data analysis

Concept and design: Aqsa Arif

Acquisition, analysis, or interpretation of data: Aqsa Arif

Drafting of the manuscript: Aqsa Arif

Critical review of the manuscript for important intellectual content: Aqsa Arif

Statistical analysis: Aqsa Arif

Obtained funding: Not applicable

Administrative, technical, or material support: Not applicable

Supervision: Not applicable

Conflict of Interest Disclosures: None reported.

Funding/Support: None

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