

The Co-Relation between Piaget's Cognitive Principles with IQ and Age Among 4-7 Years Old Children: A Descriptive Cross-Sectional Study

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Abstract

Original Research Article

Background: Learning is an agent necessity process for man; man is born on this earth weak, incapable and helpless. Through learning man can be graded until he become able to face life's problems and his inability turns to be innovate impossible things. **Aim and Objective:** The purpose of this study was to assess Piaget's principles of the intuitive stage of Pre-Operational period among 4-7 year old children relative to their I.Q. **Materials and Methods:** This cross-sectional study was conducted among 240 children, aged 4-7 years. Various characteristics, specific for this age group, such as Egocentrism, concept of concentration and reversibility Seguin board test for IQ and two interview questions were assessed. All participants were provided with a full explanation and purpose of the study. **Results:** The results of the study show that Egocentrism, lack of Centration and Concept of Reversibility were appreciated in most of the children between 4 and 7 years of age and most of Piaget's principles are still valid today.

Keywords: Centration; Children; Cognitive development; Egocentrism; Jean Piaget; Preoperational period.

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INTRODUCTION

The Development of Physiological growth lies in continuous activities and explorations for children in the process of growing up [1]. Cognitive development is a major area of human development and was extensively studied by Jean Piaget [1, 2]. The term Cognition means knowing or understanding [3].

Piaget proposed that the development of intellectual abilities occurs in a series of relatively distinct stages and that a child's way of thinking and viewing the world is different at different stages. Since the thinking of a child is different from that of adults, one cannot expect a child to process and utilize information in the same way that an adult would. Therefore, for efficient communication with a child, it is necessary to understand his/her intellectual level and the ways in which thought processes work at various stages [3, 4].

Seguin Form Board is widely used in both Research and Clinical practice as a performance test of intelligence for young children in our country [1, 2]. This observational study were undertaken to provide a database and assess Piaget's principles of the intuitive stage of pre-operational period among 4-7 year old South Indian children relative to their I.Q.

It has also intended to evaluate whether or not the features of previous stage diminish and successive stage establish with age.

METHODOLOGY

Study area

This descriptive Cross-Sectional study was conducted at Govt schools located in and around Tirupati, India.

Ethical considerations

Before the beginning of the study, ethical approval was obtained from the ethical committee of Dental College, Tirupati. Official permission to examine the school-children was obtained from the school authorities of both schools and written informed consent was obtained from parents of children who participated in the study. The school principal and parents were explained about the purpose and procedures of the study.

Inclusion criteria

- Children of age group 4-7 years.
- Children willing to participate in the study.

Exclusion criteria

- Children of age above 7 years.
- Children not present on the day of the study.

- Children who were not willing to participate in the study.
- Special children were excluded.
- Children who were in pilot study were excluded from the study.

Study Population

All the children were of Asian Indian origin. The sample size were 240 (120 boys and 120 girls) children in the age group of 4-7 years.

Care was taken, to include children of the same socio-economic status. The age, socio-economic status and the ethnicity of the child were obtained from the school records. The children were divided into three sub groups based on their chronological age

- Group I: 4-5 years.
- Group II: 5-6 years.
- Group III: 6-7 years.

Informal screening by the investigator was carried out to ensure that all the children had normal or corrected visual abilities.

Sampling Technique (Assessment Tools used Principles).

- Seguin Form Board (SFB).
- Piaget's Cognitive theory.

On the pre decided days, the investigator visited four schools. With the help of school authorities class rooms were arranged.

Two hundred and forty children were selected randomly and they were made to sit in the classroom.

Seguin Form Board (SFB)

IQ was tested using Seguin Form Board test to assess visual discrimination, matching and eye-hand coordination. Test materials consisted of eight differently shaped wooden blocks and a large form board with recesses corresponding to these shapes [1-2].The testing was administered individually to each child, in compliance with the guidelines and direction of the Seguin form board test manual and the scorings were as recorded. Stanford-Binet fifth edition classification. (SB-5) [8].

IQ testing kit was placed on the table and children were asked to come one by one and perform the test. While administering the test, these blocks were taken out by the examiner and stacked in front of the subject who had to put them back as quickly as he/she could.

The following instructions were given to the students: "Here are eight wooden blocks which have to be put by you in the appropriate space. Be as fast as you can. You will be allowed only three trials." Prior to starting the test proper, a 'ready' signal were given and

at the second signal 'start', child started placing the wooden blocks. The timing with stop watch was matched with the child picking up the first block. The task was repeated three times. Time, in seconds was obtained for each trial by the investigator, who seated beside and slightly to the back of the subject to be tested. The total time score of each subject in three trials, their average and the shortest time score were obtained.

IQ of each child assessed using Seguin Form Board Test (Figure 1)

Piaget's Cognitive theory principles

Four experiments were carried out and the entire children were asked two interview questions in person to assess the classical characteristics of Piaget's theory among these children. They were:

- Perceptual Egocentrism.
- Cognitive Egocentrism.
- Concept of Centration.
- Concept of Reversibility.

The experiments used in the study are based on Piaget's Cognitive theory. Experiment designs for each characteristic are as follows:

Perceptual egocentrism (figure 2)

Egocentrism is the inability to take another person's perspective or point of view. It is the assumption that others view the world as one does oneself. It does not mean that the child is selfish but rather the child lacks the ability to consider another person's point of view.

It was assessed by the classical two sets of same toy experiment as explained by Piaget. The child and the interpreter sat across a table. Toys of two same superheroes were placed on the table in front of the child and he/she was asked if he/she could see them. After the child confirmed that he/she could see both of them, an obstruction were placed in between the two toys such that the child could still see both the toys. Then he/she was asked if he/she could still see the superhero toys. After an affirmative reply, the child was asked if the two superheroes could see each other.

A positive reply indicated the presence of Perceptual Egocentrism in the child. An Egocentric child often picks their own view rather than the doll's view as he/she was unable to understand another person's perspective.

Cognitive egocentrism (figure 3)

The children were shown six different toy animals and are asked to tell his/her favorite and least liked animal amongst them. After obtaining a response from the child, a mean monkey was introduced to the child and he was told that the mean monkey always took away their favorite animal. It was also explained

that the mean monkey was unaware of which animal was the child's favorite and that it would first ask him/her and then take it.

The child was asked to save their animal. The experiment was carried out after explaining the entire procedure. The child was given three chances, to save his animal. If the child pointed to his favorite animal after being asked by the monkey in all the three trials, he/she was considered to possess the characteristic of Cognitive Egocentrism.

On the contrary, if the child was able to fool the monkey by pointing to a animal other than their favorite, Cognitive Egocentrism was considered to be absent in him/her.

Concept of centration (figure 4, 5)

To assess the concept of Centration task, the CLASSICAL BEAKER EXPERIMENT was performed.

The child was presented with two identical beakers having the same amount of colored liquid. Then the liquid from one beaker was poured into a third taller and thinner beaker in front of the child. The child was asked to identify the beaker that contained more liquid. If the child pointed out the taller beaker as the one containing more liquid, he/she was marked to possess the concept of Centration. The child was unable to cognitively reverse the series of events, mentally returning the poured liquid to its original container because of the concept of Irreversibility. Thus, the child fails to understand that the two amounts of liquids were still the same.

Concept of reversibility (Figure 6)

To assess the presence of concept of Reversibility, the child was shown two similar linear worms of same length made up of same amount of clay. After the child confirmed that the two worms had an equal amount of clay, one worm was changed to a spiral snail in front of the child without addition or removal of any clay. The child was then asked if both the worms still had an equal amount of clay. If the child replied with a positive answer, it indicated that the child could reverse the procedure of conversion of straight worm into wiggly worm and could understand that only the shape of the worm was changed without change in amount of clay, thus possessing the concept of Reversibility.

Concept of egocentrism and reversibility in dental settings

This cross-sectional study was conducted in the Department of Pedodontics and Preventive Dentistry. Two interview questions were asked to each child to assess the presence of Egocentrism and concept of Reversibility in Dental settings.

They were

To assess the presence of Egocentrism in Dental setting, each child were shown a set of different pictures and were asked what he/she would want to do after his/her Dental treatment.

The child was asked to choose a picture regarding what his/her best friend should do after their Dental treatment. If the child chose the same picture for his/her best friend as he chose for him/herself, the child was considered to be Egocentric (Figure 7).

To assess the presence of reversibility in Dental setting, each child were shown a series of pictures depicting a sad and dirty tooth, the tooth brushing itself and a happy and clean tooth in the same order.

The child was then asked what he/she could do to keep his /her teeth happy. Children who could explain that brushing the teeth and cleaning them was required to keep the teeth happy were marked, as ones who had mastered the concept of Reversibility. (Figure 8).

Method of Data Analysis

The data collected were analyzed using frequency counts and simple percentage.

Statistical Tools Used For the Study

The data collected was entered on to the spreadsheets and was analyzed using Statistical Package for Social Sciences version 21.0(SPPS 21.0) and Shapiro Wilk test were used to check the normality of the data. Inferential statistics were performed using Kruskal Wallis test. The level of statistical significance was set at 0.05.

Analysis and Interpretation of Data

Completed surveys were coded, and spreadsheets were created for data entry. The survey results were manually entered into a personal computer by a research assistant who was not aware of the study objectives. The data were "cleaned" by checking for entries outside of legitimate ranges and for inconsistent codes; the necessary corrections were made by manually rechecking the surveys.

Percentages for each variable were based on the number of respondents for the corresponding experiments.

RESULTS

General characteristics of study sample

A number of findings resulted from this study. Statistical analyses were computed based on the relationship between the reported uses of some techniques.

The data was first checked for assumptions of normality, to see if the dependent variable is normally distributed for each group for the independent variables namely, age and gender.

Gender-wise distribution of study population among the three age groups was not significantly different. Males and females were equal in all the groups. The distribution of children according to their IQ category was significantly different among various age groups.

Analyses of the experiments used in the study are based on Piaget's Cognitive theory as shown in *Table 1, 2, and 3.*

The mean IQ score of 4-5 year age group 93.5% (75) was significantly higher than that of 5-6 year age group 80% (64) which was further significantly higher than that of 6-7 year olds 85%(68) as shown in *Graph 1.*

The prevalence of Perceptual Egocentrism based on the favorite toy experiment was found to be significantly higher among 4-5 year age group 82.5%

(66) as compared to other two age groups as shown in *Graph 2.*

Based on the prevalence of Egocentrism in was different among 4-5 year age group 76.2 % (61) among all age groups as shown in *Graph 3.*

The prevalence of Cognitive Egocentrism-Dental and based on the face to face interview question was 91.5 % (73) among 4-5 year age group as shown in *Graph 7.*

Based on the beaker experiment, lack of Centration was found to be significantly higher among 5-6 yr age group 83.7 % (67) as compared to other two age groups as shown in *Graph 4.*

The Concept of Reversibility (worm test using clay) revealed that of the children among all age groups be significantly higher among 6-7 year age group 97.0%(78) as shown in *Graph 5.*

All the children in 6-7 yr age group possessed the Concept of Reversibility in Dental setting based on the interview question, which was significantly higher 88.7% (71) as compared to 81.2%(65) among 4-5 yr age group as shown in *Graph 6.*

Table-1: Showing age wise comparison of IQ score

IQ CATEGORY Stanford-Binet Fifth edition Classification. (SB-5)								
GROUP	EXTREMELY LOW n (%)	BODERLINE n (%)	LOW AVERAGE n (%)	AVERAGE n (%)	HIGH AVERAGE n (%)	SUPERIOR n (%)	VERY SUPERIOR n (%)	TOT AL
I (4-5 years)	6 (7.5 %)	5 (6.2 %)	7 (8.7 %)	20 (25 %)	19 (23.5 %)	9 (11.2 %)	14 (17.5 %)	80
II (5- 6 years)	2 (2.5 %)	2 (2.5 %)	7 (8.7 %)	20 (25 %)	8 (10 %)	24 (30 %)	17 (21.2 %)	80
III (6-7 years)	2 (2.5 %)	4 (5 %)	11 (13.7 %)	8 (10 %)	12 (15 %)	13 (16.2 %)	30 (37.5 %)	80
TOTAL	10 (4.2 %)	11 (4.5 %)	25 (10.4 %)	48 (20 %)	39 (16.2 %)	46 (19.2 %)	61 (25.4 %)	240

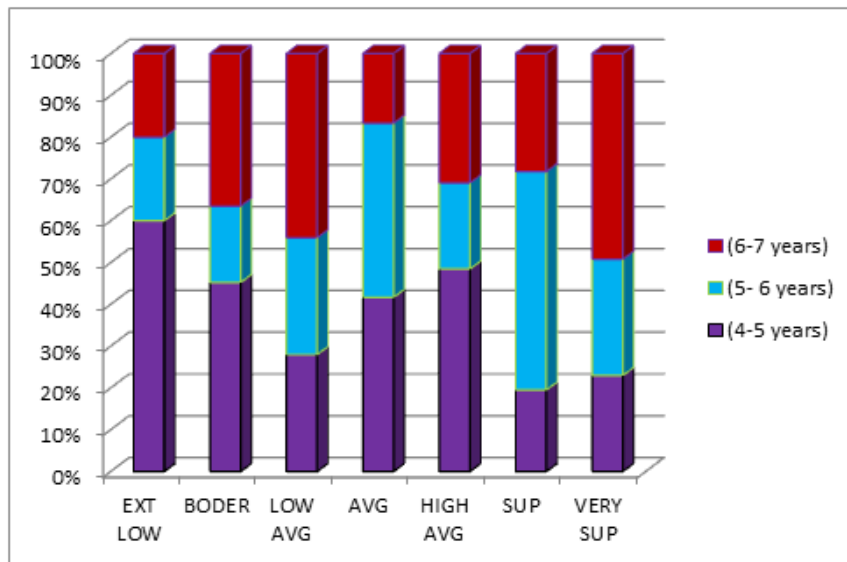
Table-2: Showing age wise comparison of Piaget's characteristics

Variables	Age Groups in years		
	I (4-5 years)	II (5- 6 years)	III (6-7 years)
Perceptual Egocentrism (PE)	82.5% (66)	70%(56)	55% (44)
Cognitive Egocentrism(CE)	76.2%(61)	61.2%(49)	48.7% (39)
Concept of Centration(CC)	82.5% (66)	83.7%(67)	82.5%(66)
Concept of Reversibility(CR)	83.7%(67)	91.2%(73)	97.0%(78)
Concept of Reversibility-Dental(CR-D)	81.2%(65)	81.2%(65)	88.7% (71)
Cognitive Egocentrism-Dental(CE- D)	91.5%(73)	71.2%(57)	52.5%(42)

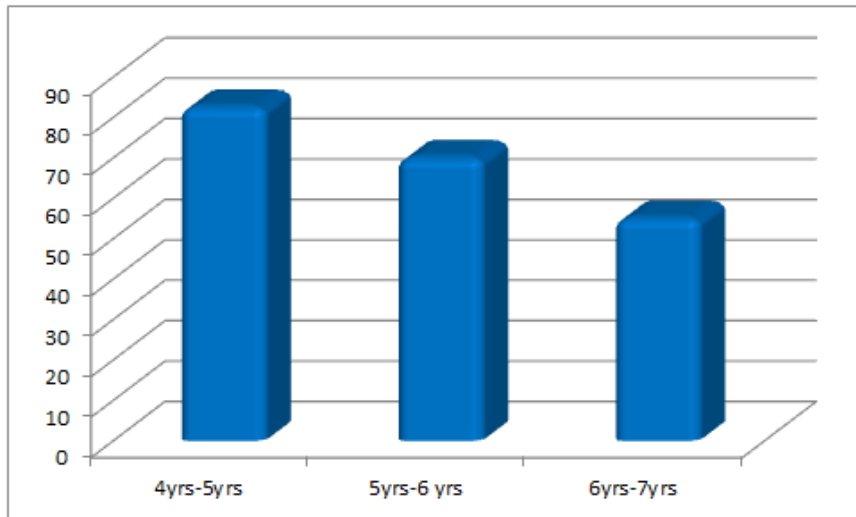
Table 3: Co-relating the mean IQ score of children with Piaget’s characteristics-Kruskal Wallis test

Characteristic of Piaget	Mean	SD	t-value	Inferential statistics
Perceptually Egocentric	51.55	3.20	21.89	p< 0.0087 SS
Perceptually Non-Egocentric	28.45	5.79		
Cognitively Egocentric	52.62	3.08	19.28	p<0.001 SS
Cognitively Non-Egocentric	27.38	5.92		
Presence of Centration	13.2	7.51	0.43	p=0.6684 NS
Absence of Centration	66.8	1.48		
Presence of Reversibility	52.08	3.14	20.45	p<0.001 SS
Absence of Reversibility	27.91	5.86		
Presence of Egocentrism in Dental setting	12.41	7.60	0.399	p=0.6910 NS
Absence of Egocentrism in Dental setting	67.59	1.39		
Presence of Reversibility in Dental setting	12.01	7.64	0.38	p=0.7042 NS
Absence of Reversibility in Dental setting	67.99	6.29		

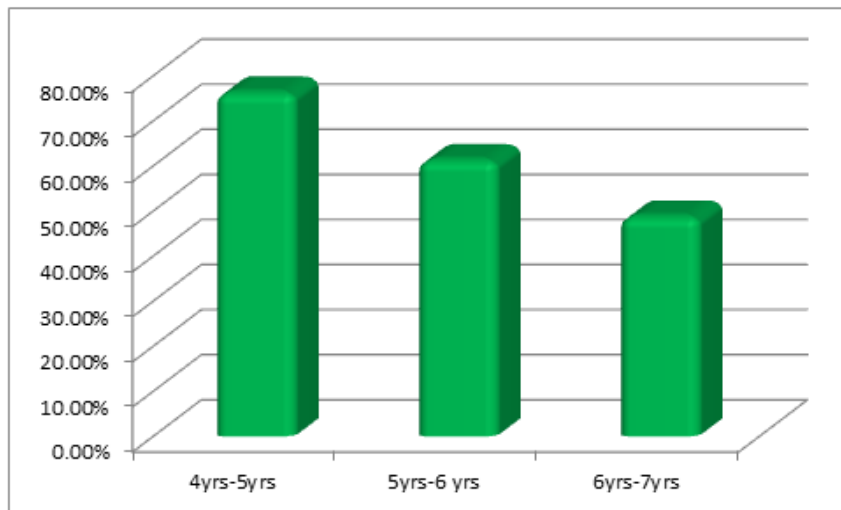
NS: Not significant; S: Significant; HS: Highly significant



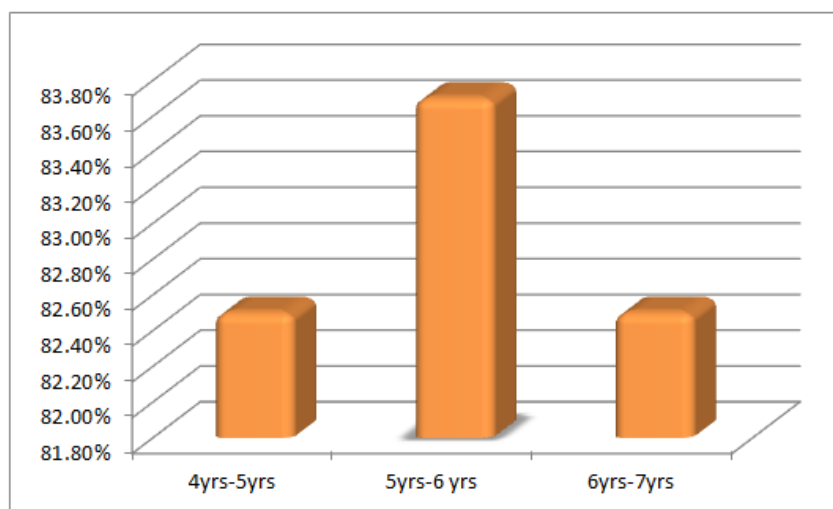
Graph-1: Showing age wise comparison of IQ score



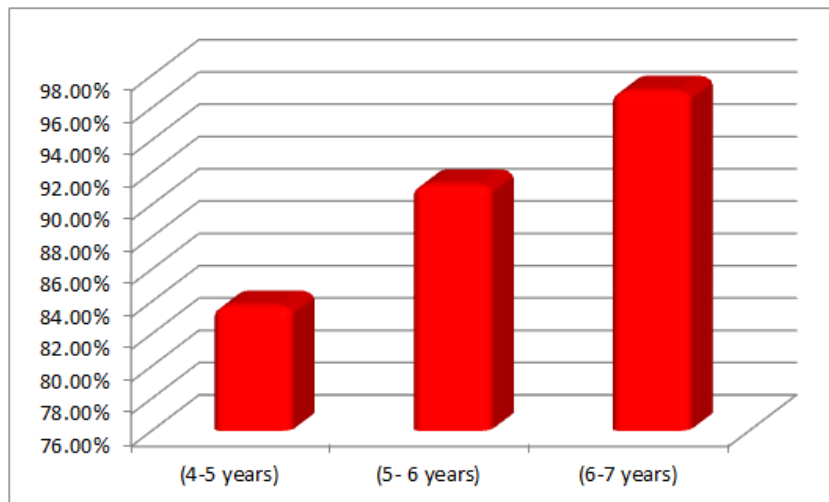
Graph-2: Showing age wise comparison of IQ scoredone with Perceptual Egocentrism. Post hoc pairwise comparison using ^bKruskal Wallis test reveals IQ (Group I) > IQ (Group II)>IQ (Group III)



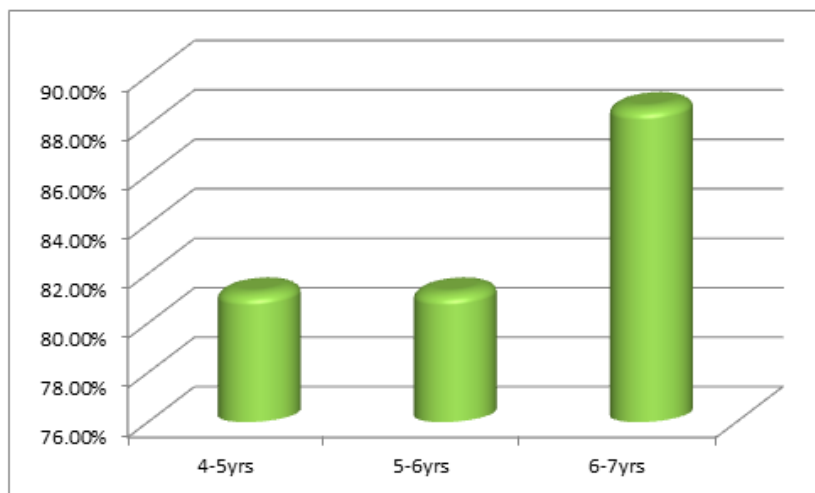
Graph-3: Showing age wise comparison of IQ scoredone with Cognitive Egocentrism. Post hoc pairwise comparison using ^bKruskal Wallis test reveals IQ (Group I) > IQ (Group II)>IQ (Group III)



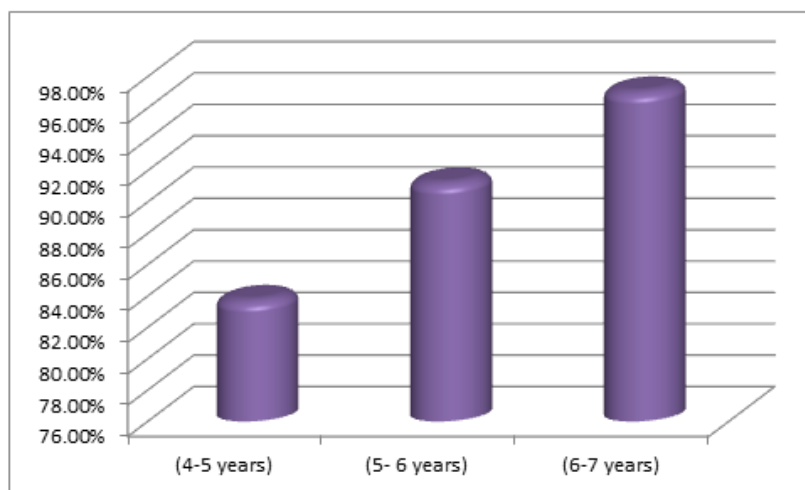
Graph-4: Showing age wise comparison of IQ score done with Concept of Centration Post hoc pair wise comparison using ^bKruskal Wallis test reveals IQ (Group I) and (Group III)<IQ (Group II)



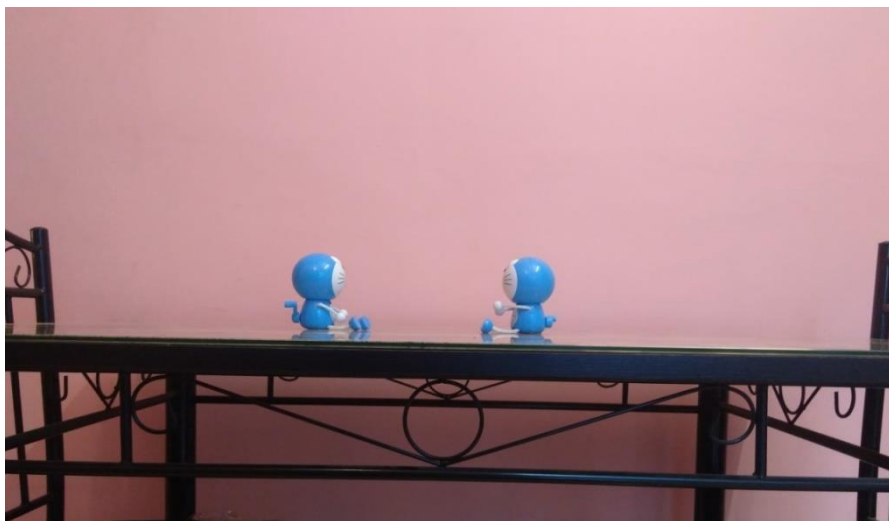
Graph-5: Showing age wise comparison of IQ score done with Concept of Reversibility. Post hoc pair wise comparison using ^bKruskal Wallis test reveals IQ (Group I) < IQ (Group II) < IQ (Group III)



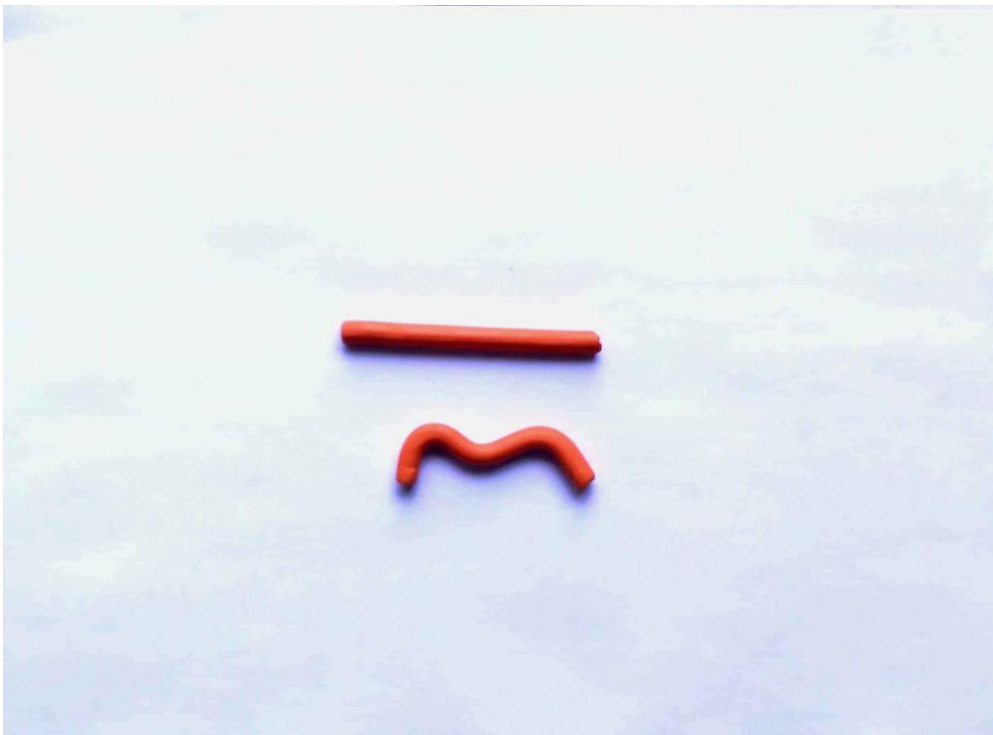
Graph-6: Showing age wise comparison of IQ score done with Concept of Reversibility-Dental settings. Post hoc pair wise comparison using ^bKruskal Wallis test reveals IQ (Group I) and (Group II) < IQ (Group III)

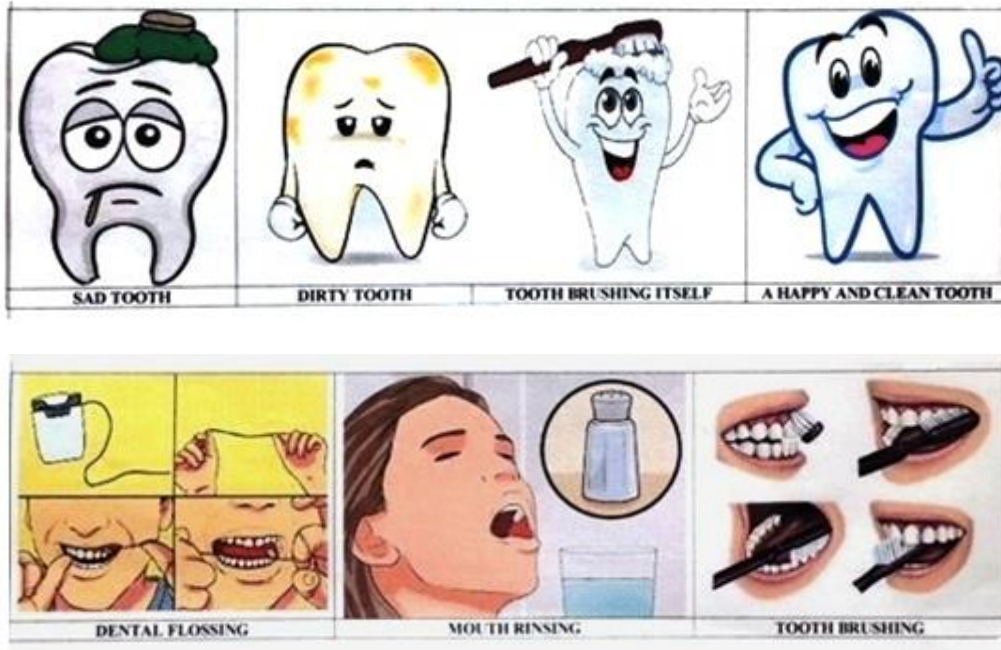


Graph-7: Showing age wise comparison of IQ score done with Cognitive Egocentrism Dental settings. Post hoc pair wise comparison using ^bKruskal Wallis test reveals IQ (Group I) > IQ (Group II) > IQ (Group III)









DISCUSSION

Cognitive (Intellectual) Schemes -A cognitive structure or what Piaget called a scheme-is an organized pattern of thought or action that is used to cope with or explain some aspect of experience [3-5].

Piaget proposed four major periods (or stages) of Cognitive development in every child: the sensorimotor stage (birth to age 2), the Preoperational stage (ages 2 to 7), the Concrete-Operational stage (ages 7 to 11 or 12), and the Formal-Operational stage (ages 11-12 and beyond) [5-7].

During the Preoperational stage, children become increasingly proficient at constructing and using mental symbols (words and images) to think about the objects, situations, and events they encounter. But despite these advances in symbolic reasoning [2-3, 5].

This period includes Preconception (2-4 years) and Intuitive stage (4-7 years). Prelogical reasoning appears in the intuitive stage. The child begins to construct more complex images and more elaborate concepts [3, 5].

These Intuitive stage children who could be difficult to behavior manage and pose a challenge to the Dentists were included in the study. Children below 4 years of age who lacked the cognitive ability to understand the study were excluded. The characteristic features common in this age group, include Egocentrism, Centration and lack of Conservation [5-7].

This paper had attempted to correlate the prevalence of these features with the age and IQ of a child. It would also help to anticipate and modify a

child's reaction in a Dental setting using various behavior management techniques based on his/her level of Cognitive development.

Seguin Form Board (SFB) is probably one of the most widely used performance tests of Intelligence for young children in our country (Goel and Bhargave, 1990 both in research as well as clinical practice). The simplicity of the test, quickness or ease of administration. Portability, facility to arouse/sustain spontaneous interest and temporal brevity are some reasons for its continued popularity [9, 10].

In the present study, the mean I.Q score of 4-5 year age group was significantly higher than that of 5-6 year olds which was further significantly higher than that of 6-7 years old which supports the principles of Piaget. The distribution of children according to their IQ category was significantly different among various age groups which ranged from extremely low to very superior.

This was in accordance with study Sugandha Marwaha *et al.* [14] which stated that IQ score of children who possessed Perceptual Egocentrism, Cognitive Egocentrism and Egocentrism in Dental setting was significantly higher than those who lacked these characteristics.

The results of this study show that all the three features are observed in most of the children between 4 and 7years of age as suggested by Piaget.

The results of the present study showed that prevalence of Perceptual Egocentrism was found to be significantly higher among 4-5 yr age group. This is in accordance with Piaget who believed that by school age

or earlier, most children have overcome this characteristic where they do not realize that other people see things from a viewpoint different from theirs. But there is continued Cognitive Egocentrism, in which children find it difficult to understand that other people do not know their thoughts. In communicating with others, children often forget to put themselves in the role of the listener.

In the present study also, prevalence of Cognitive Egocentrism was not found to be significantly different among all age groups which further supports the principles of Piaget.

Based on the interview question, the prevalence of Egocentrism in Dental setting among all age groups was not significantly different. It also reveals a decrease in Egocentrism with age. This was in accordance with study Asokan S *et al.* [12]. Which concluded that a gradual reduction of the prevalence of Egocentrism based on the question about the gift after Dental treatment.

Pre-Operational thought also focuses on a single striking feature of an object or event, a tendency called Centration.

Lack of Centration was found to be significantly higher among 6-7 yr age group as compared to other two age groups. This shows that, there is a gradual and significant reduction in the prevalence of Centration with increase in age. This was in accordance with study Nelly Scheuner *et al.* [13].

According to this study, most of the children among all age groups lacked the concept of Reversibility and there was no statistically significant difference with respect to that.

Based on the interview question, all the children in 6-7 yr age group possessed the concept of Reversibility in Dental setting which was significantly higher as compared to among 4-5 yr age group. This might be because of an increased awareness about the importance of tooth brushing, role of media or a previous exposure to a Dentist and Dental health education. This was in accordance with study Fields HW *et al.* [11].

There was no statistically significant difference in the mean I.Q score of children who possessed or lacked the concept of Centration and concept of Reversibility. Hence no relation between Piaget's principles and I.Q could be established. This could be attributed to a greater number of subjects giving the incorrect response which was expected out of them according to their age. Had the study undertaken an older age group, where fairly more number of subjects gave correct responses, a co-relation with I.Q. would be more significant.

CONCLUSION

This cross-sectional study provides an insight of the distribution and prevalence of classical characteristics described by Piaget and correlates them with the IQ of 4-7-year-old children.

The results of the study show that Egocentrism, lack of Centration and Concept of Reversibility were appreciated in most of the children between 4 and 7 years of age and most of Piaget's principles are still valid today.

Ethical disclosures

- Protection of human and animal subjects: The authors declare that no experiments were performed on humans or animals for this study.
- Confidentiality of data: The authors declare that no patient data appear in this article.
- Right to privacy and informed consent: The authors have obtained the written informed consent of the patients or subjects mentioned in the article. The corresponding author is in possession of this document.

Conflict of interest & source of funding

The author declares that there is no special financial support for this research work from the funding agency and there is no conflict of interest among all authors

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