

The Effect Of Learning Gymnastics Skills On Non-Verbal Cognitive Abilities In Childhood

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Abstract

This study aimed at identifying the effect of learning gymnastics skills on some non-verbal cognitive abilities in childhood. The researchers adopted the descriptive approach. The study sample consists of (20) children who were chosen in a deliberate way, divided into two groups; 1st group consists of (10) gymnasts, including (7) males and (3) females, while the second group consists of (10) children who do not practice gymnastics or any other sport, including (7) males and (3) females, who were classified according to Jean Piaget's stages of cognitive development. Leiter-3 Scale of nonverbal intelligence and cognitive abilities and Memo Scale were used. The study results indicated that the level of visual perceptual abilities of children practicing gymnastics was average for the both age groups (7-11 years) and (11-14 years) and above average for intelligence. Children practicing gymnastics in both visual perceptual abilities and intelligence index on non-practicing children. The researcher recommends the necessity of paying attention to motor activities, especially gymnastics, in the developmental stages of the child, because it has a role in developing non-verbal cognitive abilities and intelligence.

Keywords: Gymnastics Skills, Non-Verbal Cognitive Abilities, Leiter-3 Scale.

Introduction

Cognitive abilities are the primary drivers of the human being, as they serve as the first electrical signal to generate energy. Attention, mental imagery, memory, cognition of all kinds, and other cognitive abilities are considered the basis of the human mind and the first motive of human. With the absence of cognitive abilities, human cannot coexist and adapt to the outside world, as they are the first basis in explaining this world to man.

In the sports field, the workers paid attention to the cognitive abilities that the player possesses, as the cognitive abilities are considered among the factors of high importance and are no less important than the physical and skill training of the player, because of their direct impact on the sporting achievement and winning, so that the higher the mental training rate of the player with Receiving the right physical training doses and at the right level, there was more chance of winning than the untrained player. The

issue of attention to cognitive abilities is very important in this era because of the convergence of sports levels and the difficulty of achieving victory unless there is training covering all aspects of the athlete.

Sports games and events are largely based on the relationship between the mental aspect and skill performance, where the success or failure of the player depends on the compatibility between cognitive and skill abilities so that the higher the level of cognitive abilities, the positively reflected on the level of sports performance. Gymnastics is one of the individual games that have a special nature for physical exercises that require a high level of cognitive abilities (mental) such as visual perception, so that cognitive abilities are considered a basis for the success of the gymnast in competitions and a basis for his safety from injuries, since the high level of perception, for example, protects the player from any damage You may injure him during gymnastics, so the

high level of cognitive abilities is important, which distinguishes one player from another.

Gymnastics requires continuous work and learning in the best ways and methods in order to develop the player in terms of movement, because gymnastics is a violent activity that requires great physical and motor abilities in addition to high-level cognitive abilities. It should be noted here that the game of gymnastics must be practiced since childhood, due to the specificity of this game and the fact that it differs from the rest of the other sports in the degree to which the player possesses the harmonic abilities, balance and agility as they are important elements of the game of gymnastics, as well as mental abilities such as speed of visual scanning, attention, focus and other mental abilities, and it can be Raising their level in childhood is easier and faster than in advanced stages, In order to ensure access to high levels in gymnastics, children must be selected in a codified and elaborate manner, through conducting tests that measure physical abilities and mental abilities. It is non-verbal, not subject to a specific language, and anyone of different languages and ages can use it. It gives a high and honest indicator of the level of mental ability, such as visual perception, which is the ability to perceive, interpret and understand visual information (), and other cognitive abilities.

Measuring cognitive abilities in childhood is very necessary, since cognitive abilities can be treated if there are any problems in them before the child reaches the age of six. In addition, cognitive abilities can be developed in childhood better and faster than the ability to develop them in advanced old stages, and since we are dealing with an important group in society, namely the children, it is necessary to use non-verbal tests since there could be samples with speech or hearing problems, or who do not understand the language of the test.

In this study, the researcher seeks to investigate the effect of learning gymnastics skills at early childhood stage on cognitive abilities.

Statement of Problem

Gymnastics is one of the important sports that helps in developing various cognitive abilities such as visual perception, and since these abilities are an important pillar for cognitive development in the stages of child development, they require special attention and need to be continuously developed. According to the researchers' experience in the field of gymnastics training in schools and the Faculty of Sports Sciences at the University of Jordan, they noted that there is a lack of interest in gymnastics in schools, especially in childhood stage, and that physical activity (PA), especially gymnastics, has an important role in developing cognitive abilities in different stages of childhood. Accordingly, the current study deals with an important group in society namely the children, and how to develop their non-verbal cognitive abilities.

Study Objectives

This study is aimed to investigate:

- 1- The level of non-verbal cognitive abilities, such as visual perception, among children in the different stages of childhood "Concrete Operational Stage (7-11), Formal Operational Stage (11-14)".
- 2- The effect of practicing gymnastics on non-verbal cognitive abilities in childhood stages "Concrete Operational Stage (7-11), Formal Operational Stage (11-14)" according to the (sex) variable.
- 3- The effect of gymnastics training on non-verbal cognitive abilities according to (age) variable.
- 4- Differences in the cognitive abilities between gymnastics and non-gymnastics in childhood stages.

Study Questions

1. What is the level of children's non-verbal cognitive abilities in the different stages of childhood "Concrete Operational Stage (7-11), Formal Operational Stage (11-14)"?
2. Is there a statistically significant effect of gymnastics practice on non-verbal cognitive abilities in childhood stages depending on the (sex) variable?

3. Are there statistically significant differences in the effect of gymnastics training on non-verbal cognitive abilities according to the (age) variable?
4. Are there statistically significant differences in the cognitive abilities between gymnastics and non-gymnastics in childhood stages?

Methods

To achieve the objectives of this study, the descriptive approach was used to suit the nature of the study.

Study Population

All gymnasts in the Jordan Gymnastics Federation within the age group (7-15) years, and all non-gymnastics children in Amman within the age group (7-15).

Study Sample

A purposive sample of (20) children were chosen and divided into two groups: the first group consists of (10) gymnasts; (7) males and (3) females, while the second group consists of (10) non-athletes; (7) males and (3) Females. Table No. (1) illustrates the description of the sample individuals.

Table (1): Description of the participants according to the variables (sex, age and years of training).

Variable	Category	Gymnasts		Non-athletes	
		n	%	n	%
Sex	Male	7	70.0	7	70.0
	Female	3	30.0	3	30.0
	Total	10	100	10	100
Age	7-11 years	5	50.0	5	50.0
	11-15 years	5	50.0	5	50.0
	Total	10	100	10	100
Years of Training	≤ 5 years	6	60.0	0	00.0
	> 5 years	4	40.0	0	00.0
	Non-athletes	0	00.0	10	100
	Total	10	100	10	100

Measures

- 1- The Leiter-3 scale of non-verbal intelligence and cognitive abilities was adopted; the part dedicated to measure visual perception, memory, and intelligence was used.

- Basic description of Leiter-3 scale.

It is an individual test designed to evaluate the cognitive functions of children, adolescents and adults, from 3 to 75 years old. The test includes measurement of non-verbal intelligence using factorial indicators such as visual perception and fluid reasoning. This scale is characterized by the presence of an electronic correction and recording system from which the results are extracted and appear in the form of a confidential

report, and it works with Microsoft Windows and Android system for tablets.

It is the most important test in measuring intelligence and non-verbal abilities, which was designed by the American scientist Gal Royd in 2013.

The Leiter-3 scale consists of 9 sub-tests; four of which measure non-verbal intelligence, two measures the level of non-verbal memory, and two measures the level of attention and processing speed, in addition to the Examiner Rating Scale.

Of the sub-tests that measure non-verbal cognitive abilities are:

- Figure-Ground (FG):

This subtest evaluates the ability to visually perceive similar shapes through a group of different shapes, where the performance of this test depends on the individual's flexibility, cognitive ability and diverting attention between a separate shape and a complex background. The examination also requires sufficient visual screening skills and effective search strategies, as well as short-term visual memory to stabilize the mental image of the card while the examinee searches for it in the image in front of him, and the examinee needs the ability to perceive the ground of the figure by knowing the extent of the ability to visually distinguish the shapes displayed in the image, and the test of the shape and ground depends on the focus on the last image.

- Form Completion (FC):

It is one of the sub-tests that depend mainly on distinguishing and perceiving the unordered pieces and matching them with the shape in the image in front of the child, where the examinee uses inductive reasoning (moving from part to whole). This test also requires an understanding of abstract relationships and measures the individual's ability to generate general rules from fragmented information and inductive assumptions that he/ she needs to complete the form from the parts, and the importance of this sub-test is that it needs good mental abilities in order to perceive the sequence of tasks to reach the final form.

- Classification and Analogies (CA):

It is one of the sub-tests that work to classify the individual's abilities to convey concepts that belong to each other and use them, regardless of shape, size and color. The child need to understand the elements by using questions to link the meaning to the element and to visualize the interconnected forms in the general picture with the responses in one existing response.

- Sequential Order (SO):

This test requires non-verbal mental abilities that focus on the examinee's ability to understand the relationships between stimuli in order to find the missing element at the end of the pattern (the picture), and when performing tasks that require understanding the arrangement of the

relationships in the pattern. Appendix (3) shows the Leiter-3 scale measuring the level of visual perception (Hamdan, 2016).

Among the sub-tests that give an indication of non-verbal cognitive abilities is the attention level test

Attention Sustained

The attention sustained test was used as a part of the Leiter-3 scale, where the child is required to find similar images or shapes during a specific time (30 seconds) to (60 seconds) according to the difficulty of finding the picture or shape according to the test instructions, and test is paused after the end of the period in order to move to the next paragraph. This test is performed using the examiner's book, a ballpoint pen, a timer watch. Appendix (5) shows the Lieter-3 scale measuring the level of attention sustained.

Nonverbal Stroop Test

This subtest requires the examinee's book - ballpoint pen – examiner's Timer

1- Color Congruent Trail: The individual is required to find similar colors in a period of (45 seconds). Appendix (5) illustrates the Liter-3 scale for measuring the selective attention of similar colors.

2- Color Incongruent Trail: The individual is required to find different colors in a period of (45 seconds). Appendix (5) illustrates the Liter-3 scale for measuring the selective attention of different colors.

Validity:

The Leiter-3 scale had several validity indicators, where the scale was applied to a sample consists of (1603) individuals, and the standard values were less than 3, -3, and this indicates that the scale is valid. The validity of the content was found through linking and finding the relationship between the scale and a set of measures of intelligence and cognitive abilities, such as the (WJ-III) test, as its validity ranged between (0.77-0.92), and the (WISC-IV) test, as its validity ranged between (87.6-87.3), and (Stanford Binet) test with a validity was (0.85) (Roid, 2013; Hamdan, 2016).

Reliability

Internal consistency reliability of Leiter-3 scale was tested through the Couder-Richardson equation -20, where the reliability coefficients mean was (0.78) and the reliability coefficient mean of the sequential order test was (0.95). The reliability of the tool was confirmed by being applied to a sample consists of (156) individuals, and the reliability coefficients ranged between (0.73-0.90) (Hamdan, 2016).

2- PA levels Scale (Woll et al., 2011), translated into Arabic by Al-Batayneh (2018). Appendix (2) shows the scale, as its reliability was (0.84) upon applied on the Jordanian environment.

Study variables: Independent variables: (learning gymnastics skills, gender, and age for

gymnastics training) Dependent variables: non-verbal cognitive abilities (visual perception).

Statistical treatments of Data:

To derive the results from the study data, the researchers used the following set of statistical treatments:

Frequencies and Percentages, Means, Standard Deviations, Mann Whitney Test

Presentation and Discussion of Results

I: Results Presentation

Question 1: What is the level of children's non-verbal cognitive abilities in the different stages of childhood “Concrete Operational Stage (7-11), Formal Operational Stage (11-15)”? In order to answer this question, the researchers presented the results in Tables (2, 3):

Table (2) Means and standard deviations of non-verbal cognitive abilities of non- gymnastics children

Non-Verbal Cognitive Abilities		Non-Gymnastics Children						Level
		7-11 years		12-15 years		Both age groups		
		Mean	SD	Mean	SD	Mean	SD	
Visual Perception	FG	12.20	2.28	14.20	2.28	13.20	2.39	Medium
	FC	11.40	2.30	10.60	0.89	11.00	1.70	Medium
	CA	8.00	1.41	7.20	2.05	7.60	1.71	Low-Medium
	SO	10.60	3.78	7.40	3.21	9.00	3.71	Medium
	Visual Cog. Average	10.55	1.16	9.85	1.53	10.20	1.33	Medium
Intelligence	IQ	100.20	7.56	96.00	10.77	98.10	9.05	Below Average

Table (2) shows the mean and standard deviation values of the non-verbal cognitive abilities among non- gymnastics children (expressed in the standard degree) according to age group. The mean value reached (10.55) for children of the age group (7-11 years) and (9.85) for children of the age group (11-14 years), while for both

groups, it reached (10.20) at a medium level. Regarding the intelligence index, the IQ mean value was (100.20) for children of the age group (7-11 years), while it reached (96.00) for children of the age group (11- 15 years), and it reached for both groups jointly (98.10) at a level below the average.

Table (3) Means and standard deviations of non-verbal cognitive abilities among gymnastics children

Non-Verbal Cognitive Abilities		Gymnastics Children						Level
		7-10 years		11-15 years		Both Age Groups		
		Mean	SD	Mean	SD	Mean	SD	
Visual Perception	FG	16.20	3.56	14.20	3.77	15.20	3.61	High
	FC	11.80	3.77	12.00	1.58	11.90	2.73	Medium
	CA	9.20	3.90	7.20	2.39	8.20	3.22	Medium

	SO	11.80	1.92	12.00	1.00	11.90	1.45	Medium
	Visual Cog. Average	12.25	2.02	11.35	0.93	11.80	1.55	Medium
Intelligence Index	IQ	110.40	11.26	105.80	5.63	108.10	8.74	Medium

Table (3) shows the mean and standard deviation values of the non-verbal cognitive abilities of the gymnastics children according to age group. The mean value reached (12.25) for children of the age group (7-11 years) and (11.35) for children of the age group (11-15 years), while it reached for both groups (11.80) at an average level.

In the intelligence index, the IQ value was (110.40) for children of the age group (7-11 years), and (105.80) for children of the age group

(11-14 years), while it reached, for both groups together, (108.10) at an above average level.

Question 2: Is there a statistically significant effect of practicing gymnastics on child's non-verbal cognitive abilities in childhood stages according to the (sex) variable?

To answer this question, the researchers used the Mann Whitney test to identify the differences in abilities between both groups as shown in the Tables (4, 5).

Table (4) Mann Whitney test for differences in non-verbal cognitive abilities between gymnastics and non- gymnastics male children (7)

Cognitive Abilities		Practicing	Sum of Salary	Salary Average	Z value	Sig.
Visual Perception	FG	Non-Gymnastics	40.00	5.71	-1.62	105
		Gymnastics	65.00	9.29		
	FC	Non-Gymnastics	47.00	6.71	-0.72	0.471
		Gymnastics	58.00	8.29		
	CA	Non-Gymnastics	48.50	6.93	-0.52	0.602
		Gymnastics	56.50	8.07		
	SO	Non-Gymnastics	38.00	5.43	-1.87	0.61
		Gymnastics	6.700	0.61		
	Visual Cog. Average	Non-Gymnastics	36.00	5.14		
		Gymnastics	69.00	9.86		
Intelligence	IQ	Non-Gymnastics	36.00	5.14	-2.2	0.034
		Gymnastics	69.00	9.86		

Table (4) illustrates the results of the Mann Whitney Test evaluating the differences in the non-verbal cognitive abilities of male gymnastics and non-gymnastics children. the values of the computed significance levels of the visual perception reached (0.105) for the FG Test, and reached (0.471) for the FC Test, while the sig.

level of CA Test reached (0.602), and the significance level value for the SO test was (0.061). The significance level for the total degree of visual perception was (0.034). The significance level and the total degree of non-verbal cognitive abilities are statistically significant because it is less than 0.05, so that the

significance of the difference was in favor of the male gymnastics children with mean value of (11.89), while it reached (10.21) for the non-gymnastics children as shown in Table (4) for this variable, while other values are not statistically significant because it is greater than 0.05, which indicates that the differences between gymnastics and non-gymnastics male children are considered not significant.

The value for IQ test reached (0.034), where this value is considered a statistical significant because it is less than 0.05, so that the significance of the difference was in favor of the male gymnastics children, whose mean value reached (108.71), while it reached (98.29) for non-gymnastics male children.

Table (5) Mann Whitney test for differences in non-verbal cognitive abilities between gymnastics male and non-gymnastics female children (3)

Cognitive Abilities		Practicing	Sum	Mean	Z value	Sig.
Visual Perception	FG	Non-Gymnastics	8.00	2.67	-1.11	0.268
		Gymnastics	13.00	4.33		
	FC	Non-Gymnastics	8.50	2.83	-0.89	0.376
		Gymnastics	12.50	4.17		
	CA	Non-Gymnastics	10.00	3.33	-0.22	0.827
		Gymnastics	11.00	3.67		
	SO	Non-Gymnastics	9.00	3.00	-0.67	0.500
		Gymnastics	12.00	4.00		
	Visual Cog. Average	Non-Gymnastics	10.00	3.33	-0.22	0.827
		Gymnastics	11.00	3.67		
Intelligence	IQ	Non-Gymnastics	10.00	3.33	-0.22	0.827
		Gymnastics	11.00	3.67		

Table (5) illustrates the results of the Mann Whitney Test evaluating the differences in the non-verbal cognitive abilities of female gymnastics and non-gymnastics children. The values of the Sig. level reached (0.268) for the FG Test, and (0.376) for the FC Test, while the sig. level of CA Test reached (0.827), and the Sig. level for the SO test was (0.061). The Sig. level for the total degree of visual perception was (0.034). The Sig. level and the total degree of non-verbal cognitive abilities are not statistically significant because it is greater than 0.05, which indicates that the differences between gymnastics and non-gymnastics female children are considered not significant.

Regarding the IQ test, the value reached (0.827), where this value is not a statistically significance because it is higher than 0.05, so that the significance of the difference between the means of the female gymnastics and non-gymnastics children are not significant.

Question 3: Are there statistically significant differences in the effect of gymnastics training on non-verbal cognitive abilities according to the age of training? To answer this question, the researchers presented results in Table (6):

Table (6) Mann Whitney test for differences in non-verbal cognitive abilities among gymnastics children according to the training age variable

Cognitive Abilities		Training Age	Sum of Salary	Number	Salary Average	Z value	Sig.
Visual Perception	FG	≥ 5	38.00	6	6.33	-1.08	0.282
		< 5	17.00	4	4.25		
	FC	≥ 5	33.50	6	5.58	-0.11	0.914
		< 5	21.50	4	5.38		
	CA	≥ 5	35.00	6	5.83	-0.43	0.668
		< 5	20.00	4	5.00		
	SO	≥ 5	33.00	6	5.50	0.00	1.000
		< 5	22.00	4	5.50		
	Visual Cog. Average	≥ 5	35.50	6	5.92	-0.53	0.539
		< 5	19.50	4	4.88		
Intelligence	IQ	≥ 5	35.50	6	5.92	-0.53	0.539
		< 5	19.50	4	4.88		

Table (6) shows the results of the Mann Whitney test evaluating the values of differences in the non-verbal cognitive abilities of children practicing gymnastics according to the training age variable through standard scores. regarding the values of the calculated significance levels for the sub-tests representing the visual perception ability, it reached (0.282) for the (shape and floor) test, and (0.914) for the Shape Completion test, while it reached (0.668) for the CA test, and the significance level for the (Sequential Orders) test was (1.00), while the significance level value was (0.539) for the total degree of visual perception ability.

As for the intelligence index, the value of the significance level reached (0.593), and this value is not statistically significant because it is greater than the significance level of 0.05, which indicates that the differences between the two training age groups in this indicator are considered not statistically significant.

Question 4: Are there statistically significant differences between gymnastics and non-gymnastics Children?

To answer this question, the researchers presented results in Table (7):

Table (7) Mann Whitney test for differences in non-verbal cognitive abilities between gymnastics and non-gymnastics children (10)

Cognitive Abilities		Practicing	Sum	Mean	Z value	Sig.
Visual Perception	FG	Non-Gymnastics	83.50	8.35	-1.64	0.100
		Gymnastics	126.50	12.65		
	FC	Non-Gymnastics	90.50	9.05	-1.12	0.265
		Gymnastics	119.50	11.95		
	CA	Non-Gymnastics	98.00	9.80	-2.06	0.039
		Gymnastics	112.00	11.20		
	SO	Non-Gymnastics	78.00	7.80	-0.06	0.039
		Gymnastics	132.00	13.20		

Cognitive Abilities		Practicing	Sum	Mean	Z value	Sig.
	Visual Cog. Average	Non-Gymnastics	78.00	7.80	-0.05	0.041
		Gymnastics	132.00	13.20		
Intelligence	IQ	Non-Gymnastics	78.00	7.80	-0.22	0.827
		Gymnastics	132.00	13.20		

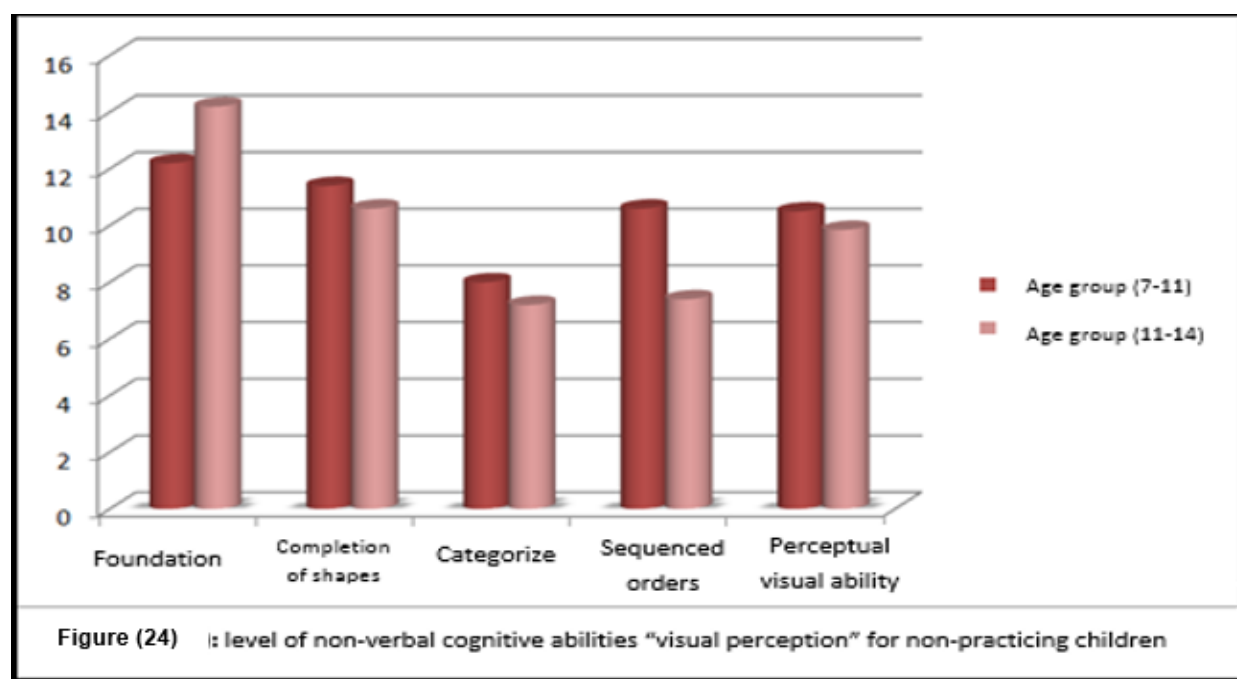
Table (7) shows the results of the Mann Whitney Test evaluating the differences in the non-verbal cognitive abilities of gymnastics and non-gymnastics children. The values of the Sig. level reached (0.265) for the FG Test, and (0.591) for the FC Test, while the sig. level of CA Test reached (0.827), and the Sig. level for the SO test was (0.039). The Sig. level for the total degree of visual perception was (0.041). The Sig. level and the total degree of non-verbal cognitive abilities are not statistically significant because it is greater than 0.05, which indicates that the differences between gymnastics and non-gymnastics female children are considered not significant.

The value of IQ test reached (0.041), where this value is statistically significant because it is less than 0.05, so that the significance of the difference between the means of the gymnastics and non-gymnastics children are not significant.

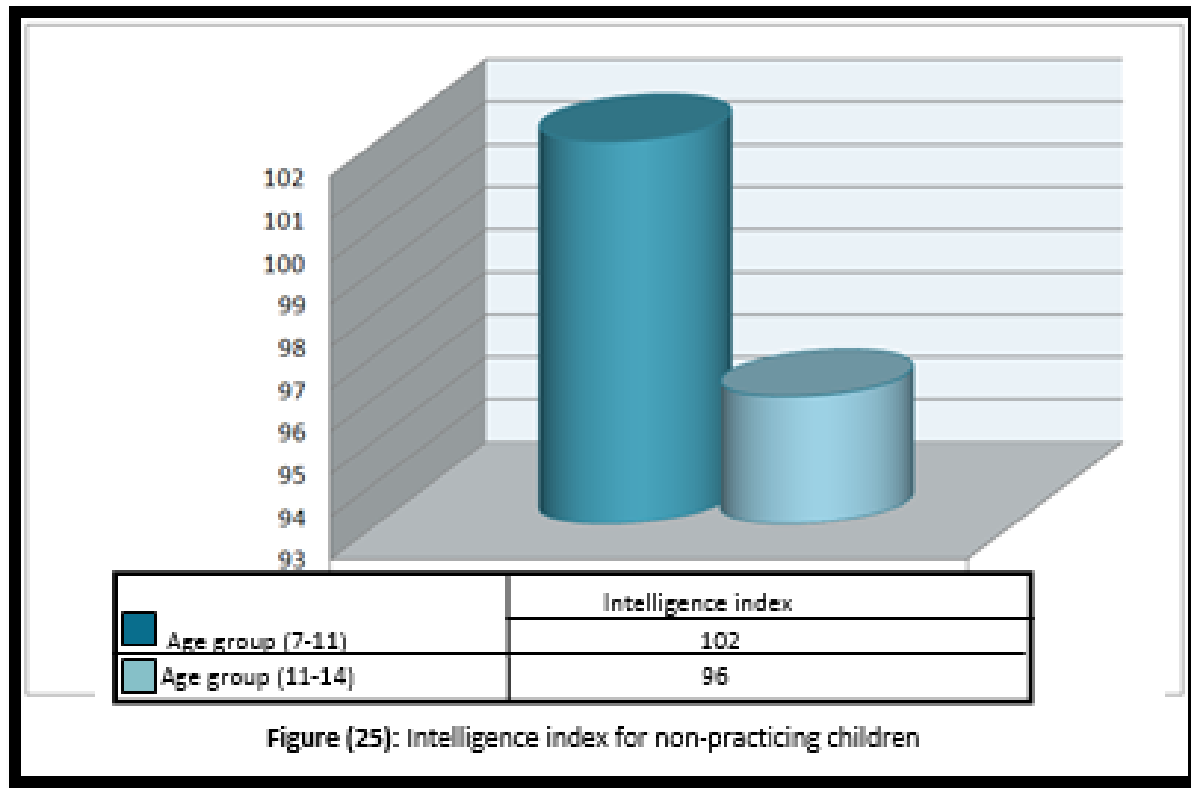
Discussion

Question 1: Question 1: What is the level of children's non-verbal cognitive abilities in the different stages of childhood "Concrete Operational Stage (7-11), Formal Operational Stage (11-14)"?

The results showed that the means of the non-verbal cognitive abilities of non-gymnastics children for the age group (7-11 years) were in medium level in the general average of visual perceptual abilities. The mentality on diverting attention between a separate shape and a complex background, the visual ability for visual scanning and short visual memory, for image stabilization and the ability to perceive the ground of the shape and focus on the axis of the final image. The children of the older age group scored the best averages in this test as shown in Figure (24).



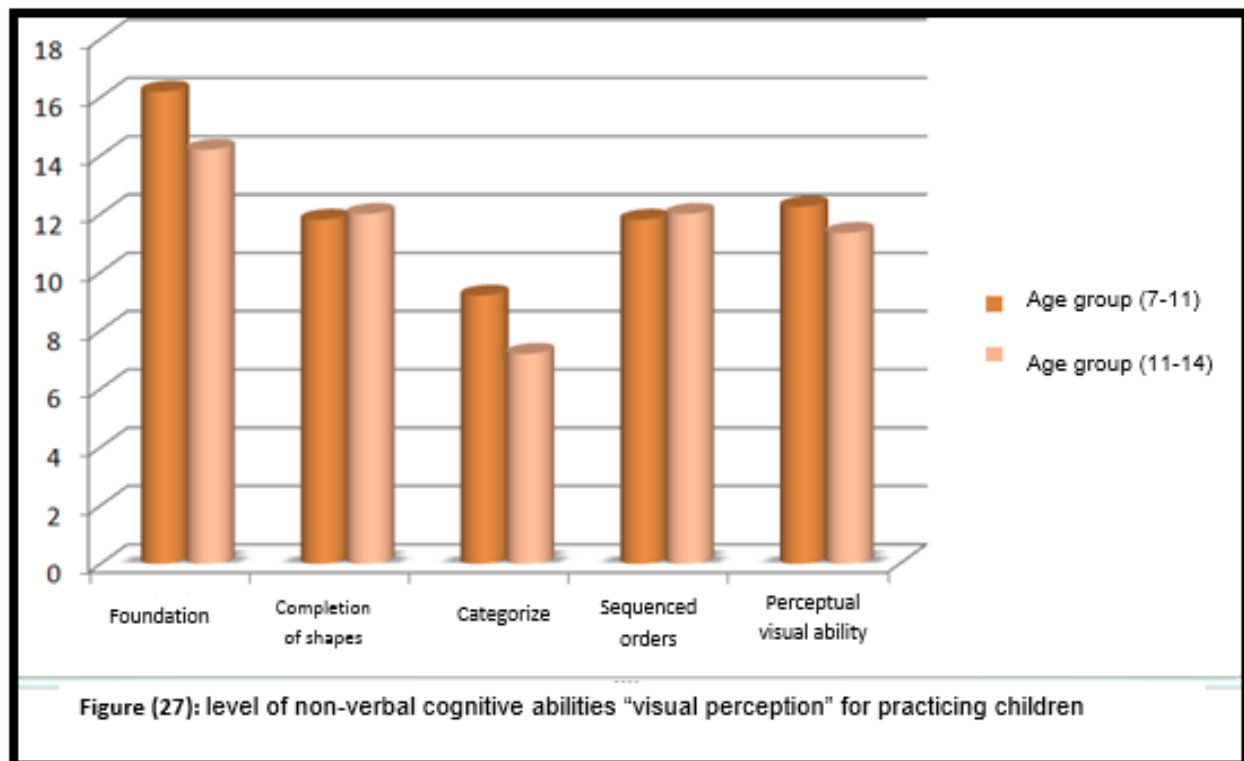
As the results of the first question showed that the intelligence index of children in the age group less than (7-11 years) was with average level, but the older age group is less than the general average of the natural intelligence index as shown in Figure (25).



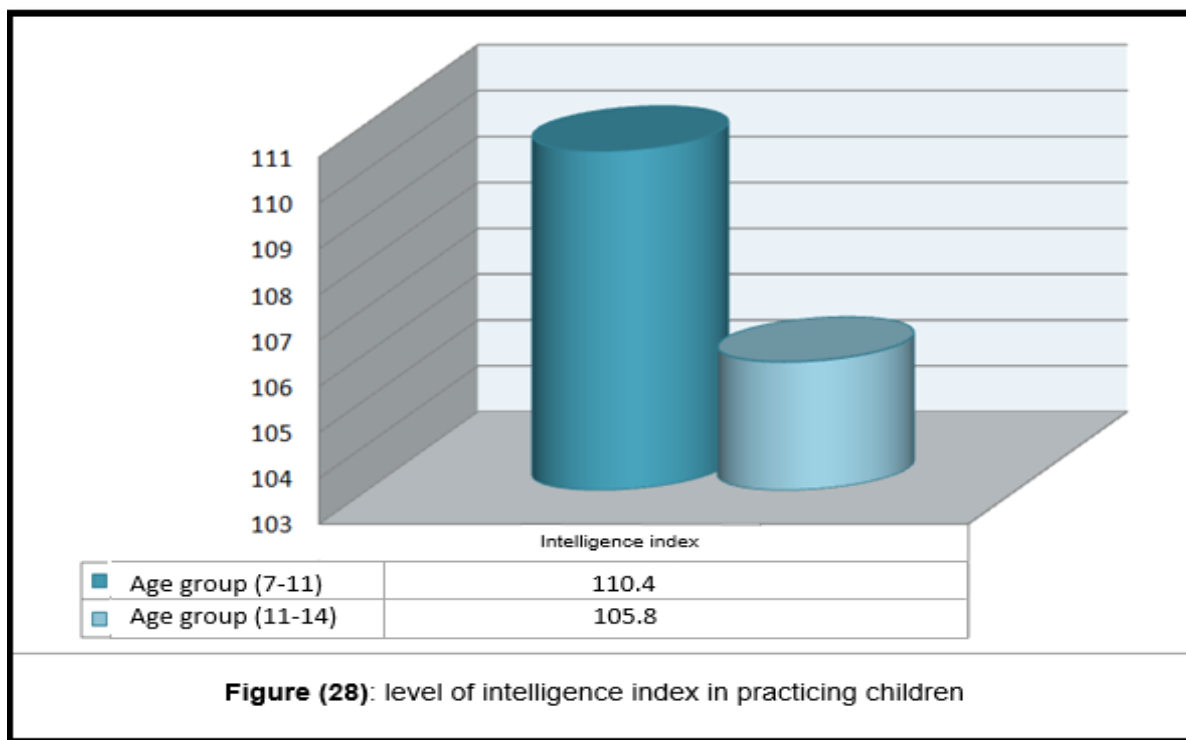
This study results came in line with the study (Obeis, 2016), where the level of cognitive abilities ranged between (average and acceptable), and the sample did not practice gymnastics or any other sport.

- As the results of the current study showed that children practicing gymnastics showed an average level in the general total of visual perceptual abilities and that the ability of shape and floor is the highest averages and at a superior

level, and that the lowest averages is the ability to (CA) where it was with average level. This test expresses the medium ability for the child to transfer concepts and use them in distinguishing between shape, size and color, where the child perceives the elements by using questions that link meaning and form with the superiority of the lower age group in these tests (7-11 years) and Figure (27) shows the level of visual perceptual abilities of gymnastics children.



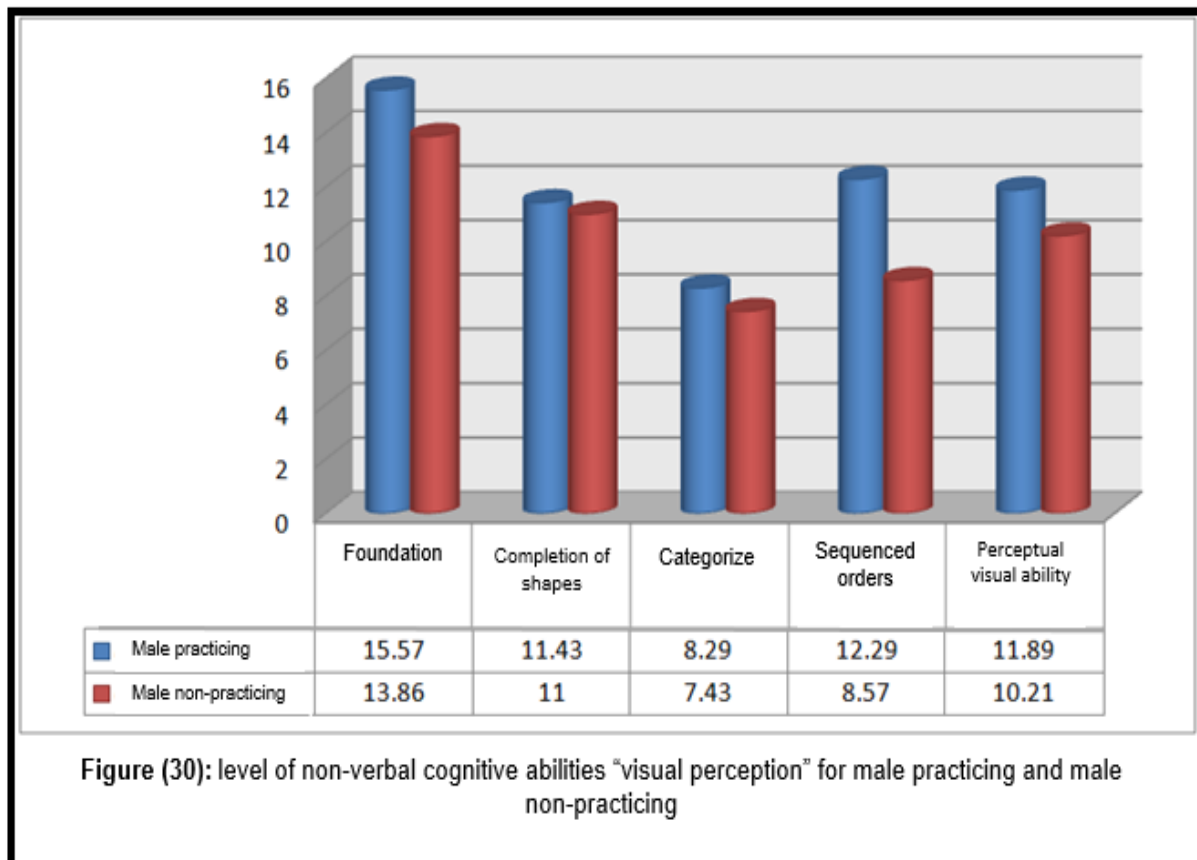
Regarding the general intelligence index, the researchers found that the general level was better for the lower age group (7-11 years), but at an above-average level for both groups, as shown in Figure (28).



Question 2: Is there a statistically significant effect of a child's gymnastics practice on non-verbal cognitive abilities according to the variable: (sex) in childhood?

Having reviewed the results of the Mann Whitney test to estimate the differences in the non-verbal cognitive abilities of male children, practitioners and non-practitioners of gymnastics, and

regarding the values of the calculated significance levels for the sub-tests representing visual perception, the results showed the superiority of the children practicing gymnastics in visual abilities at a significance level of (0.034). Figure (30) shows the level of non-verbal cognitive abilities "visual perception" of gymnastics and non- gymnastics male children.



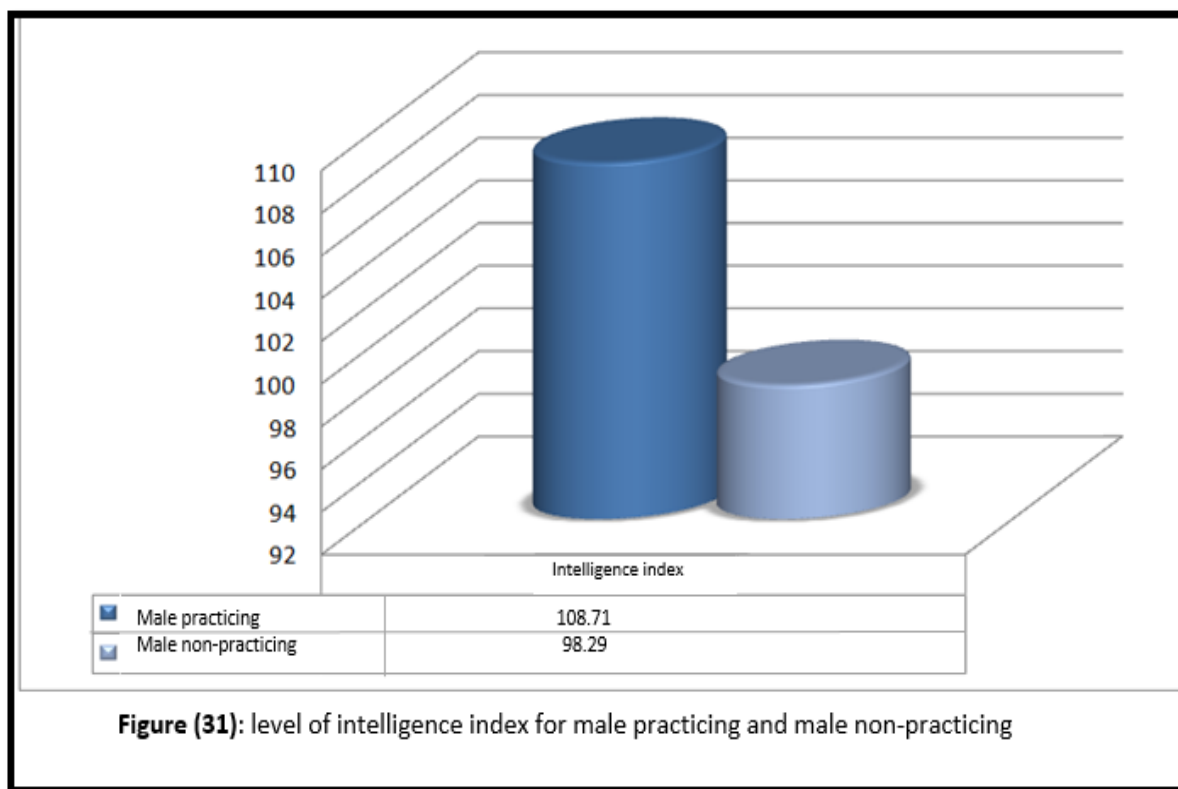
This result came in consistent with the study of (Saad and Shabeira, 2017), where their study was similar to the current study in the age group, and their study concluded that sports activities (small popular games) significantly affect the development of cognitive abilities, and it also agreed with the study of Nama and Abdel Hadi (2007), where their study was similar with the current study in the age group of the study sample (children), and their study concluded that motor activities develop the cognitive abilities of the child in the early stages, and the current study agreed also with the study of (Ardoy et al., 2014), where the results of their study indicated that the training period of 4-month with sports activities

lead to the development of non-verbal cognitive abilities. In addition, the current study agreed with the study of zach et al. (2015), where their study concluded that sports activities lead to the development in visual processing abilities and also lead to develop processing. It also agreed with the study of Shu-Shih Hsieh et al. (2017), where it was similar to the current study in the sample of the study of gymnastics children and concluded that gymnastics training had an impact on the development of cognition in the early childhood stage.

The gymnastics male children also excelled in the intelligence index with a significance level of 0.034 and a global level above the average when

comparing this result with children who do not practice gymnastics; as it was lower than the average (98.29). Figure (31) shows the

intelligence index of practicing male children and non-practicing male children.



The current study investigates the effect of gymnastics also on females, and the results of the Mann Whitney test of non-verbal cognitive abilities of gymnastics and non-gymnastics female children. The sub-tests representing visual perception indicate that there are no statistically significant differences among gymnastics and non-gymnastics females, the researchers attribute these results to the small size of the sample.

As for the IQ test, the results showed that there were no statistically significant differences in the IQ between gymnastics and non- gymnastics females. The researchers attributed that to the sample size which is 6 children.

Question 3: Are there statistically significant differences in the effect of gymnastics training on non-verbal cognitive abilities according to the age of training?

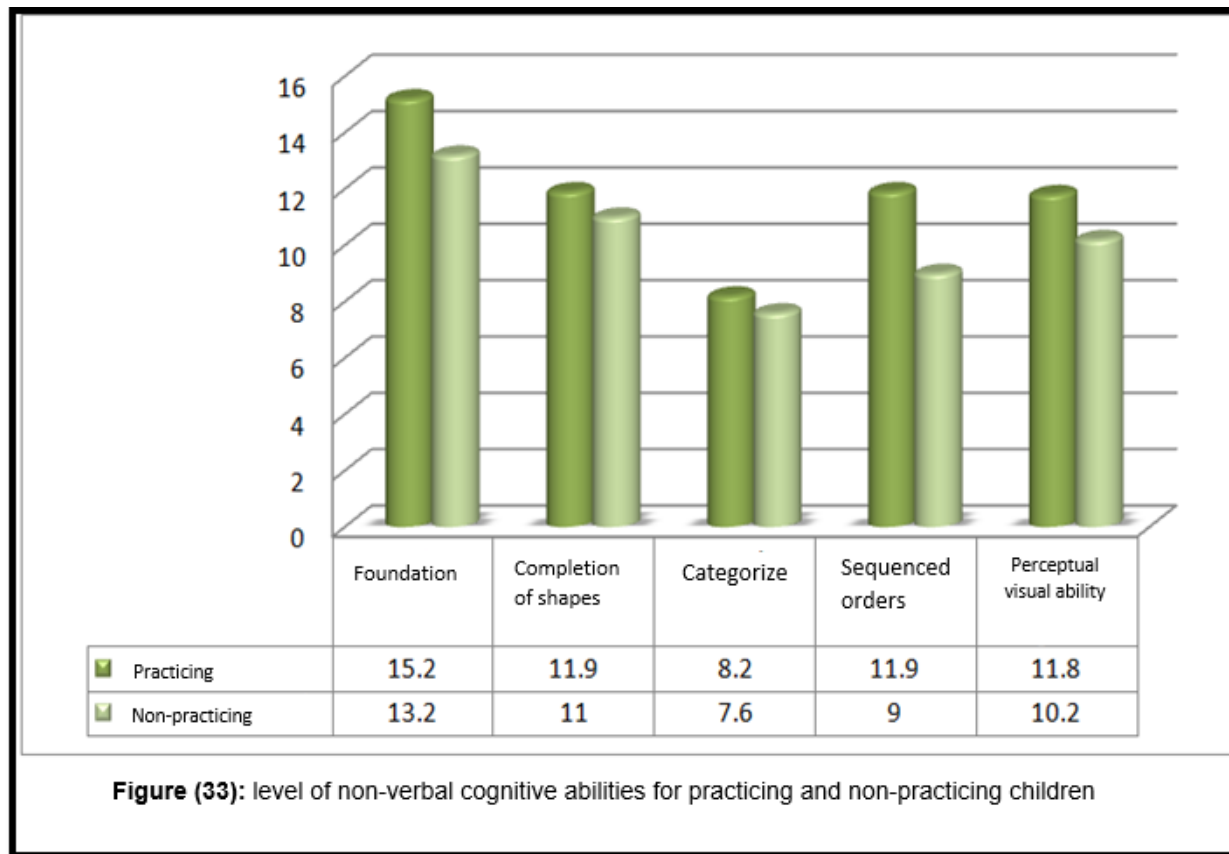
The study results revealed that there were no statistically significant differences between gymnastics children according to the training age variable in non-verbal cognitive abilities (FG, SC, CA, SO).

The results also did not show any differences in the IQ test values, and the researchers attribute that to the fact that the study sample of gymnasts who receive physical and motor training without pay attention to the mental training, but rather trainings related to the development of strength, flexibility, speed, endurance and agility.

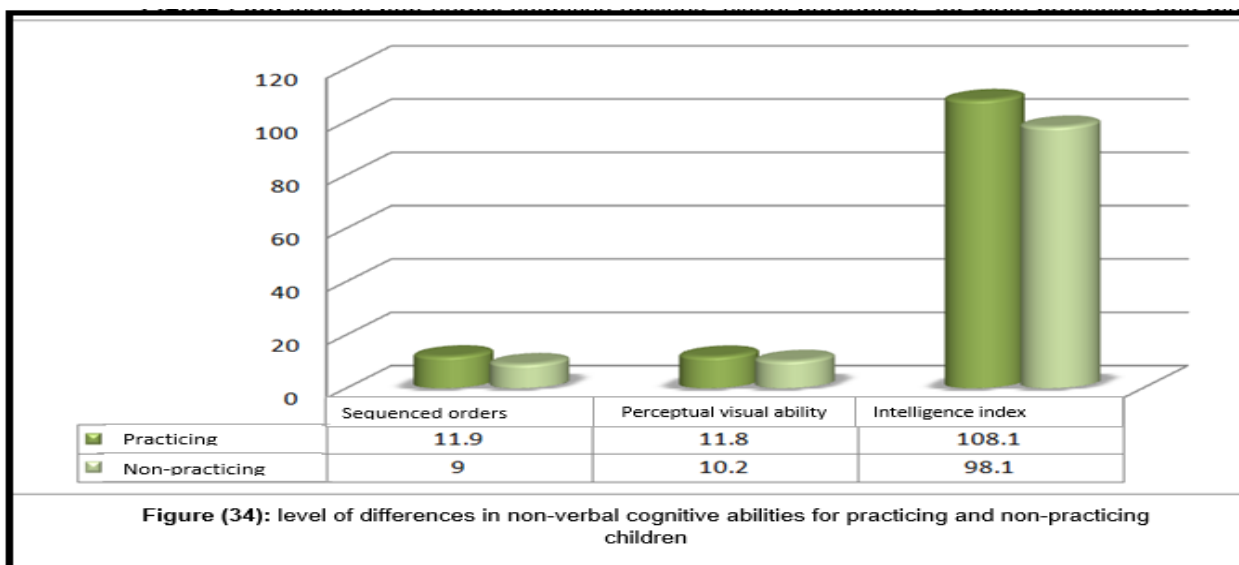
Question 4: Are there statistically significant differences between gymnastics and non-gymnastics Children?

The results indicate that there were statistically significant differences between gymnastics and non- gymnastics children in visual perceptual abilities, where children practicing gymnastics

excelled in all sub-tests except for the CA ability. Figure (33) shows the cognitive abilities of gymnastics and non- gymnastics children.



The results also revealed that there are statistically significant differences between the gymnastics and non-gymnastics in the IQ test results in favor of gymnastics children, as shown in Figure (34).



The statistically significant differences in visual abilities and IQ are in line with the studies of (Abdul Hadi, 2007; Obeis, 2016; Mohareb, Shallal, and Rashid, 2017; Saad and Shabeira, 2017; Ardoy et al., 2014; zach et al., 2015; Shu-Shih Hsieh et al. 2017), since their studies confirmed that physical and motor exercises and gymnastics exercises develop some mental abilities, especially in childhood, and such development in cognitive abilities leads to the emergence of differences between practitioners and non-practitioners of sports activities. Due to the scarcity of studies that have been interested in gymnastics, and within the limits of the researchers' knowledge, researchers believe that sports activities and gymnastics training have an important role in developing cognitive abilities based on the results of the current study.

Conclusion

In light of the study results, the researchers conclude the following:

1. The level of children's non-verbal cognitive abilities (concrete operations stage (7-11 years) was average for visual perceptual abilities and intelligence).
2. The level of cognitive abilities of children "Formal operational stage (11-14 years)" is average in visual perceptual abilities and less than the average in the intelligence index
3. The level of visual perceptual abilities of gymnastics children is average for both age groups (7-11 years) and (11-14 years), and also above average for intelligence and talented
4. The superiority of male children practicing gymnastics in visual perceptual abilities and IQ over non- gymnastics male children.
5. The superiority of children practicing gymnastics in both visual perceptual abilities and IQ over non- gymnastics children.

Recommendations

In light of the study findings, the researchers recommend the following:

1. The need for educational programs in childhood to include motor sports activities, specifically gymnastics, because of its role in developing mental and cognitive abilities.

2. Conducting assessment tests for the level of cognitive mental abilities using different scales applied on larger samples.

3. Conducting comparative studies of the results of this study on a sample of the same age group with open sports such as handball and football.

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