



## The effectiveness of a water sports program on the level of poly unsaturated fatty acids and the severity of the disease in children with Autism spectrum disorder

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### Article History

Received: 02 September 2019

Reviewed: 04/September/2019 to 20/October/2019

Accepted: 23 October 2019

Prepared: 26 October 2019

Published: January - February 2020


### Citation

Mona Mostafa Abdou Sakoury, Mohammed Nader Shalaby, Ahmed Mohammed Elmaghraby, Israa Mohamed Omar, Mai Mostafa Abdelsadek Tahoun. The effectiveness of a water sports program on the level of poly unsaturated fatty acids and the severity of the disease in children with Autism spectrum disorder. *Medical Science*, 2020, 24(101), 143-164

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## ABSTRACT

The current research aims to identify the effectiveness of a recommended water sports program on the concentration levels of poly-unsaturated fatty acids and the effectiveness of the program on the severity of autism. The researchers used the experimental approach on a sample of (5) children with Autism Spectrum Disorder. Cars test (DSM-5) and lab tests were used for gathering data. Results indicated high levels of ploy-unsaturated fatty acids in blood samples of participants in addition to improvements on (relations with others – mimicry – emotional response – body use – objects use – activity level – verbal communication – non-verbal communication – visual response – auditory response – mental response) due to the positive effects of the recommended water sports program. The researchers recommended generalizing the application of the recommended program in addition to forming an integrated rehabilitation team to stay with autistic children including a doctor, a psychiatrist, a social worker, a sports specialist and an academic specialist.

**Keywords:** ASD - poly-unsaturated fatty acids - water sports.

## 1. INTRODUCTION

Evolutionary disorders affecting young children recently gained major interest due to their negative effects on children's evolution and future life. This interest is not limited to identifying causes of such disorders, as they are actually present. Instead, it extended to finding quick interventions that prevent the problem for getting worse in addition to improving those children's abilities in a young age to easily face future life challenges (Shalaby et al., 2012a).

Autism Spectrum Disorder (ASD) requires early intervention. Al-Rawi (1998) indicated that early intervention during first years of the child's life is necessary as some nervous and sensation centers are still growing and can be easily modified and directed. This can overcome some patterns of motor and emotional behaviors as they can be easily modified into more socially accepted patterns with the decrease of abnormal behavioral patterns as disorder in one aspect of the child's character affects other sides. Autism is a very serious, difficult and severe emotional disorder as it affects individual's behaviors, his/her ability to learn and train in addition to his/her ability to work. This is because of individual defects in communication and social interaction in addition to the negative effects of withdrawal behavior (Shalaby et al., 2012b).

Autism affects brain functions, social life and communication skills. Children and individuals with autism usually face problems in verbal communication, non-verbal communication, social interactions and recreational activities. Autism causes difficulties in communication with others and relatedness to the outside world. Autistic individuals may show abnormal repetitive behaviors. In some cases, autistic children seem aggressive towards the others and the self (Al-Abadi, 2005), since it was introduced to research field for the first time by Kannar (1943). Autism gained major interest in USA, Europe and the whole world. Several researchers worked on autism since it was first described. Several theories appeared concerning its causes, diagnosis, qualities of autistic children and prevalence. What is more important is that we became more optimistic concerning autism and autistic individuals (Al-Refai, 1999; Al-Shami, 2004).

Abd Al-Daiem (2016) indicated that autism can be treated if early interventions are applied Poly-unsaturated fatty acids are of major importance for children with autism, lack of attention, hyperactivity and schizophrenia. Those children suffer a massive lack in poly-unsaturated fatty acids. Previous studies indicated that there is clear increase in physiological markers indicating deficiency of poly-unsaturated fatty acids in plasma and red blood cells of children with autism (Khalil, 2006; ), Al-Osili, 2013). Good knowledge of autism helps providing autistic children with the suitable environment that provide him/her with necessary linguistic and non-linguistic skills, communication skills and avoiding undesired behaviors. This enables autistic children to be integrated into the society through kinetic games, behavioral programs, integration programs and recreational programs. Sports programs play a major role in forming positive attitudes among children with disabilities and helping them to lead a more socially and psychologically interactive life (Farghaly, 2001). Autistic children suffer a massive lack in poly-unsaturated fatty acids. Previous studies indicated that

there is clear increase in physiological markers indicating deficiency of poly-unsaturated fatty acids in plasma and red blood cells of children with autism (Khalil, 2006; Cynthia 2000).

According to review of literature concerning children with autism, the researchers found out that this group didn't have sufficient interest compared with other groups of children with disabilities. In addition, there is a significant lack of awareness among parents about autism symptoms leading to misinterpretation of these symptoms. This, in turn, leads to delay of early intervention leading to more deterioration of negative effects of this disability in addition to the severe lack of well-qualified and trained medical, educational and psychological cadres qualified to deal with this group of children (Morsy, 2001; Ten and Gerg, 2006). Unlike children with other disabilities, autistic children didn't show clear indicators of disability, but they suffer from some aspects including weak social interaction, isolation, introversion and lack of desire for simultaneous play with peers. This is not because they are unable to play. Instead, this is because playing is difficult in itself with repeated failure leading to disappointment and lack of motivation. Although cases of autism seem similar, they share minor differences (Rateb, 1990; Nivan, 2014). Soliman (2005) indicated that children with autism suffer a clear lack of using non-verbal behavior including eye-contact, facial expressions, body positions and gestures. Further, they suffer failure in developing relations and lack of desire for social play (Nasr El-Din, 2004; Ibrahim, 1998).

Children with autism refuse to leave their own world. They look uninterested in their surrounding others, including other children of the same age and disability. They show minor interest in participating in activities. This has negative effects on poly-unsaturated fatty acids and severity of disorder. Badr I. (2004) indicated that children with autism had no individually-tailored educational program that helps each child to develop his/her disabled abilities through revealing his/her problems and needs during an objective evaluation process (Soliman, 2005). Water games therapy helps children with autism to feel their existence as human beings in world they share and enjoy with others. Play helps them express their opinions in objects and feel joy or sadness through play and toys they are talking to under supervision of a functional therapist. Play therapy helps improving the child's ability to imagine and learn about things (Al-Abadi, 2005).

Water exercises play a major role in the success of the well-planned therapy in water for children with autism. Water pressure on the body immersed in water all the time provides the soothing sensory stimulation required to calm down this very sensitive to touching child. Pressure and viscosity help autistic children suffering from shake of gravity. In-water activities help the child to assess his own body limits in addition to organizing power exerted during play and performing tasks. This makes the child avoid harming himself or others in addition to enhancing his/her body shape and ability for coordination. All this improves concentration, sleep pattern and eating habits in addition to increasing the levels of poly-unsaturated fatty acids through medium intensity physical exercises leading to metabolizing body fats into glycerol and fatty acids (Rateb, 1990; Martineau, 1994). For children with autism, poly-unsaturated fatty acids maintain flexibility of the brain membrane as Docosahexaenoic acid of Omega 3 group and Arachidonic acid of Omega 6 group are two main components of the brain with 20% and of the cortex with 30%. According to review of literature, the researchers tried to identify the effects of a water sports program on the concentration level of poly-unsaturated fatty acids and severity of disorder among children with Autism Spectrum Disorder (Khalil, 2006; Berken and Shermer, 2001).

## Aims

The current research aims to identify the effects of a water sports program on the concentration level of poly-unsaturated fatty acids and severity of disorder among children with Autism Spectrum Disorder according to the following steps:

- Designing a water sports program for children with Autism Spectrum Disorder.
- Identifying the effects of the recommended program on the concentration level of poly-unsaturated fatty acids of children with Autism Spectrum Disorder.
- Identifying the effects of the recommended program on the severity of disorder among of children with Autism Spectrum Disorder

## Hypotheses

- There are statistically significant differences between the pre- and post-measurements of the concentration level of poly-unsaturated fatty acids in favor of post-measurements.
- There are statistically significant differences between the pre- and post-measurements of the severity of disorder in favor of post-measurements
- There are improvement percentages between the pre- and post-measurements of the concentration level of poly-unsaturated fatty acids and severity of disorder in favor of post-measurements among children with Autism Spectrum Disorder.

## Terminology

1. Autism Spectrum Disorder (ASD): A developmental disorder that affects all aspects of the child's development (cognitive – physical – emotional – social) leading to negative effects (Al-Khouly, 2007; Al-Kot, 1999).
2. Poly-unsaturated fatty acids: Acids including one or more dual bond in the molecule. The first unsaturated bond in fatty acids is found in carbon 6 atom (n-6) and carbon 3 atom (n-3) of the methyl edge. In Oleic acid, it is found in carbon 9 atom (n-9) (Shalaby, 2012c; Bong, 2009).
3. Severity of Autism Spectrum Disorder: The degree of disorder between simple to complex. Children with autism show great variability in their abilities and disabilities according to the severity of the disorder (Mohamed, 2003).
4. The Water Sports Program: A group of simple sports activities and games that is easy to perform accompanied by joy and cheerfulness in addition to competitiveness. It doesn't include any complex motor skills nor rules. It is flexible, easy and simple with a purpose and principles to perform.

## 2. MATERIALS AND METHODS

### Approach

The researchers used the experimental approach (one-group design) with pre- and post-measurements.

### Limits

#### Time frame

The study was initiated over (18) weeks

#### Place

The researchers applied the recommended water sports program in the swimming pool of Aswan Sports club – Governorate of Youth and Sports – Aswan – Egypt, for the following reasons:

- a) The swimming pool is suitable for the program
- b) Coaches, assistants and administrative employees are available for assistance.
- c) Safety and security measures are followed in this pool.
  - Blood samples were taken at Saint Maria Medical Lab in Aswan.
  - Lab tests for poly-unsaturated fatty acids were performed at the central labs of the Higher Institute of Public Health – Alexandria – Egypt

### Human limits

Participants were purposefully recruited from children with Autism Spectrum disorder (7-9 years). Seven children were divided into a pilot group (n=2) and a main application group (n=5).

### Participants

Five children with Autism Spectrum Disorder were purposefully chosen from Al-Tarbia Al-Fekria School. The researcher applied the recommended water sports program on them in the swimming pool of Aswan Sports Club. Participants were recruited according to the following criteria:

1. Parents' consent on participation and taking blood samples for scientific purposes only
2. Diagnosis of Autism Spectrum Disorder
3. The children are free of any other diseases or disorders that may affect results
4. Punctuality in attending the training program.
5. The children are not recruited in any other scientific research works

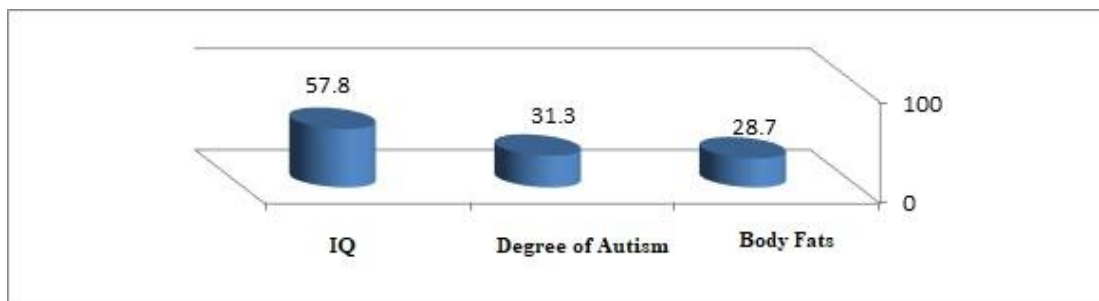
To confirm sample homogeneity, pre-measurements were taken for all research variables as follows:

**Table 1** Means, SD and Squewness of pre-measurements of body fats, autism degree and IQ for participants (n=5)

| Variables | Mean   | SD    | Least Value | Highest Value | Median | Squewness |
|-----------|--------|-------|-------------|---------------|--------|-----------|
| Body Fats | 28.700 | 2.759 | 25.8        | 32.3          | 28.20  | 0.387     |

|               |        |       |    |      |       |       |
|---------------|--------|-------|----|------|-------|-------|
| Autism Degree | 31.300 | 0.908 | 30 | 32.5 | 31.50 | 0.267 |
| IQ            | 57.80  | 2.280 | 55 | 60   | 58.00 | 0.228 |

Table (1) showed that squewness values ranged from 0.228 to 0.387 (between  $\pm 3$ ). This clearly confirms sample homogeneity.

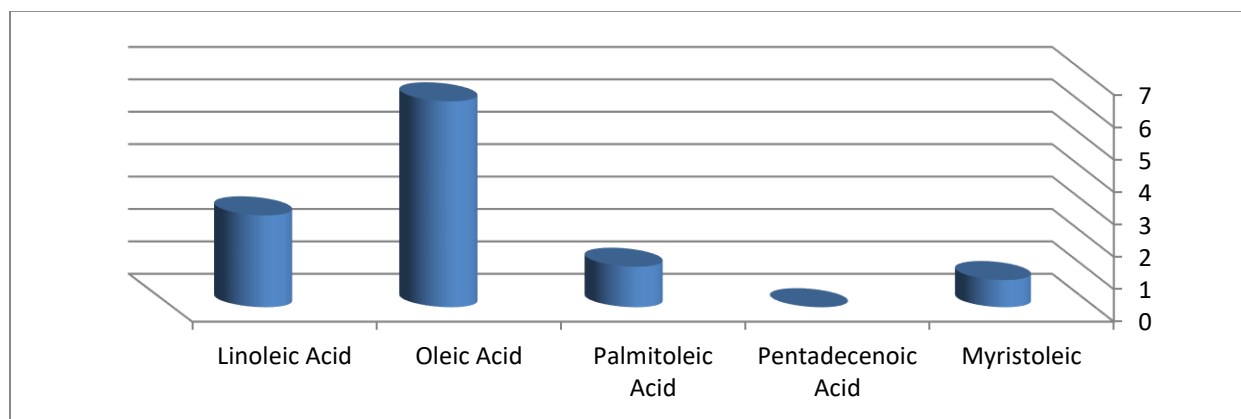


**Figure 1** Means, SD and Squewness of pre-measurements of body fats, autism degree and IQ

**Table 2** Means, SD and Squewness of pre-measurements of poly-unsaturated fatty acids for participants (n=5)

| Variables          | Mean  | SD    | Least Value | Highest Value | Median | Squewness |
|--------------------|-------|-------|-------------|---------------|--------|-----------|
| Myristoleic        | 0.839 | 0.554 | 0.422       | 1.789         | 0.740  | 1.785     |
| Pentadecenoic Acid | 0.00  | 0.000 | 0.000       | 0.000         | 000    | 000.0     |
| Palmitoleic Acid   | 1.25  | 0.562 | 0.490       | 1.895         | 1.091  | 0.196     |
| Oleic Acid         | 6.354 | 5.910 | 2.638       | 16.833        | 3.966  | 2.137     |
| Linoleic Acid      | 2.835 | 1.091 | 1.607       | 4.605         | 2.628  | 1.173     |

Table (2) & figure 1 showed that squewness values ranged from 0.00 to 2.137 (between  $\pm 3$ ). This clearly confirms sample homogeneity.



**Figure 2** Means, SD and Squewness of pre-measurements of poly-unsaturated fatty acids

**Table 3** Means, SD and Squewness of pre-measurements of poly-unsaturated fatty acids for participants (n=5)

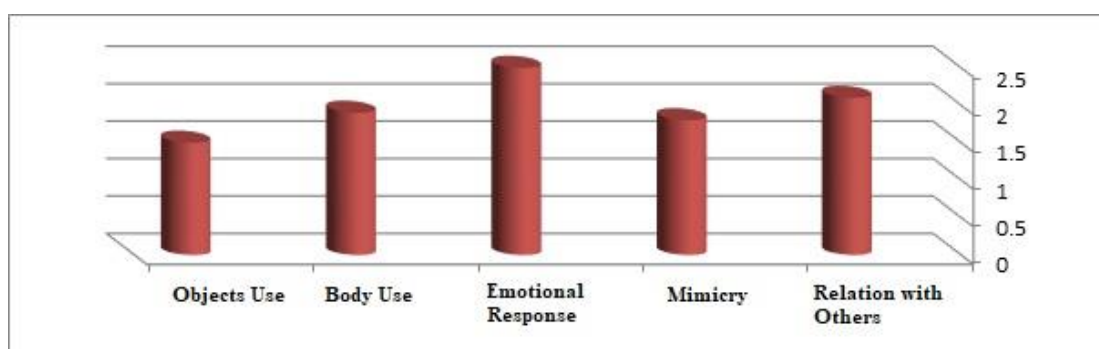
| Variables                                   | Mean  | SD    | Least Value | Highest Value | Median | Squewness |
|---|-------|-------|-------------|---------------|--------|-----------|
| C18:3w3 (Linolenic Acid)                    | 0.128 | 0.287 | 0.00        | 0.643         | 0.00   | 2.236     |
| C20:2 (Cis-11,14 –Eicosatrienoic Acid)      | 0.000 | 0.000 | 0.00        | 0.000         | 0.00   | 0.000     |
| C20:3w6 (Cis -8,11,14- Eicosatrienoic Acid) | 0.289 | 0.646 | 0.00        | 1.446         | 0.00   | 2.236     |
| C22:1w9 (Erucic Acid)                       | 0.000 | 0.000 | 0.00        | 0.000         | 0.00   | 0.000     |

Table (3) & figure 2 showed that skewness values ranged from 0.00 to 2.236 (between  $\pm 3$ ). This clearly confirms sample homogeneity.

**Table 4** Means, SD and Skewness of pre-measurements of severity of disorder (1) for participants (n=5)

| Variables            | Measurement | Mean  | SD    | Least Value | Highest Value | Median | Skewness |
|----------------------|-------------|-------|-------|-------------|---------------|--------|----------|
| Relation with others | Point       | 2.100 | 0.547 | 1.5         | 3.0           | 2.00   | 1.293    |
| Mimicry              | Point       | 1.800 | 0.273 | 1.5         | 2.0           | 2.00   | 0.609    |
| Emotional response   | Point       | 2.500 | 0.000 | 2.5         | 2.5           | 2.50   | 0.000    |
| Body use             | Point       | 1.900 | 0.223 | 1.5         | 2.0           | 2.00   | 2.236    |
| Objects use          | Point       | 1.500 | 0.000 | 1.5         | 1.5           | 1.500  | 0.000    |

Table (4) showed that skewness values ranged from 0.00 to 2.236 (between  $\pm 3$ ). This clearly confirms sample homogeneity.

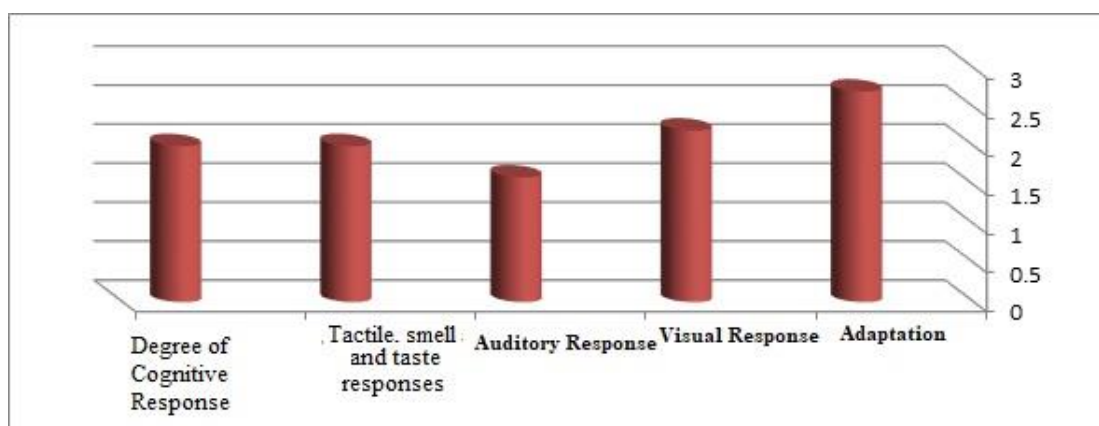


**Figure 3** Means, SD and Skewness of pre-measurements of severity of disorder (1)

**Table 5** Means, SD and Skewness of pre-measurements of severity of disorder (2) for participants (n=5)

| Variables                          | Measurement | Mean  | SD    | Least Value | Highest Value | Median | Skewness |
|------------------------------------|-------------|-------|-------|-------------|---------------|--------|----------|
| Adaptation                         | Point       | 2.700 | 0.273 | 2.5         | 3.0           | 2.500  | 0.609    |
| Visual responses                   | Point       | 2.200 | 0.273 | 2.0         | 2.5           | 2.000  | 0.609    |
| Auditory response                  | Point       | 1.600 | 0.223 | 1.5         | 2.0           | 1.500  | 2.236    |
| Tactile, smell and taste responses | Point       | 2.000 | 0.000 | 2.0         | 2.0           | 2.000  | 0.000    |
| Degree of cognitive response       | Point       | 2.000 | 0.000 | 2.0         | 2.0           | 2.000  | 0.000    |

Table (5) showed that skewness values ranged from 0.00 to 2.236 (between  $\pm 3$ ). This clearly confirms sample homogeneity.

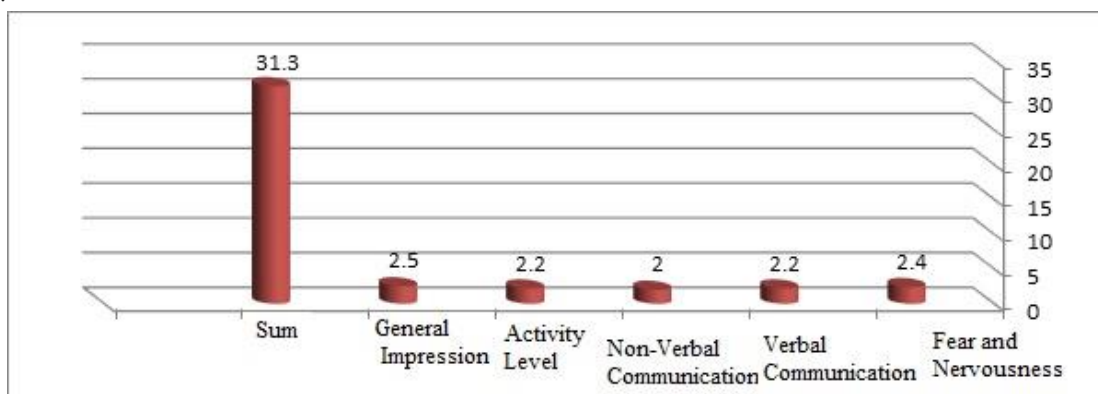


**Figure 4** Means, SD and Skewness of pre-measurements of severity of disorder (2)

**Table 6** Means, SD and Squewness of pre-measurements of severity of disorder (Al-Abadi, 2005) for participants (n=5)

| Variables                | Measurement | Mean   | SD    | Least Value | Highest Value | Median | Squewness |
|--------------------------|-------------|--------|-------|-------------|---------------|--------|-----------|
| Fear and Nervousness     | Point       | 2.400  | 0.223 | 2.0         | 2.5           | 2.500  | 2.236     |
| Verbal Communication     | Point       | 2.200  | 0.447 | 2.0         | 3.0           | 2.000  | 2.236     |
| Non-verbal communication | Point       | 2.000  | 0.000 | 2.0         | 2.0           | 2.000  | 0.000     |
| Activity Level           | Point       | 2.200  | 0.447 | 1.5         | 2.5           | 2.500  | 1.258     |
| General Impression       | Point       | 2.500  | 0.000 | 2.5         | 2.5           | 2.500  | 0.000     |
| Sum                      | Point       | 31.300 | 0.908 | 30          | 32.5          | 31.500 | 0.267     |

Table (6) and figure 4 & 5 showed that squewness values ranged from 0.00 to 2.236 (between  $\pm 3$ ). This clearly confirms sample homogeneity.

**Figure 5** Means, SD and Squewness of pre-measurements of severity of disorder (Al-Abadi, 2005)

### Data Collection Tools

According to review of literature, the researchers chose the following tools and equipment for gathering data:

- The recommended water sports program
- Parents' consent form
- School administration consent form and pool administration consent for
- Data recording form
- A restameter for measuring heights (cm)
- A medical balance for measuring weights (kg)
- BMI index
- Body fat percentage (%)
- Automatic PPT for taking blood samples
- Chromatographic analyzer for analyzing poly-unsaturated fatty acids in blood samples
- Stanford Binet IQ test
- Cars test
- (DSM-5) scale for Autism diagnosis

The recommended water sports program was validated for reliability through presenting the program to a group of experts (professors of faculties of physical education). Experts' agreement on the program reached 100%.

### Pilot Study

Pilot study was performed from 1-6-2016 to 28-7-2016 on a pilot sample (n=2) representing the same community but outside the main sample, to verify psychometric qualities of the measuring tool. The pilot study aimed to:

1. Interview experts (professors of faculties of physical education and the National Institute for Health in Alexandria)
2. Gaining approval to use the swimming pool of Aswan Sports Club



3. Interview participants and their parents to fill in the questionnaire
4. Assigning assistants and a lab technician for taking blood samples.
5. Identifying the lab or hospital where blood samples will be analyzed.
6. Identifying measurements used in this research
7. Identifying the axes of the recommended water sports program and presenting them to experts. Providing and validating tools and equipment.
8. Results of the pilot study:
9. All required tools and equipment were provided and validated.
10. Identifying children of Al-Tarbia Al-Fekria school in Aswan as a representative sample
11. Identifying Saint Maria lab in Aswan for taking blood samples
12. Forming the final version of the recommended water sports program.

### Main study

Main study took (12) weeks

### Pre-measurements

Pre-measurements were taken as follows:

#### A. Chemical measurements of blood sample

Blood samples were taken early in the morning to measure concentration of poly-unsaturated fatty acids in blood serum. Participants should fast for at least (8) hours in rest (without effort) before taking the sample. Intra-venous blood (10 ml) was taken from each participant for lab tests. Blood samples were taken as follows:

1. The participant sits on a chair with his left arm on a table.
2. Forearm is warped with a rubber cord
3. Blood sample was taken by a specialized doctor in a plastic syringe
4. Place of puncture is clear with disinfectant
5. Blood sample is put on a test tube labeled with the child's name and number.
6. The tube is analyzed on a chromatography device.
7. A paper role comes out with results.

#### B. Anthropometric measurements

Body height, weight and fat percentages in addition to BMI index are taken for all participants.

#### C. IQ test

IQ level was measured for all participants using Stanford-Binit test

#### D. Severity of Autism Spectrum Disorder Syndromes

Cars test and DSM-5 were used to diagnose severity of disorder.

### The recommended water sports program

The program is a group of sequenced steps and procedures that improve the individual's physical fitness and enables him/her to fulfill the requirements and tasks of the performed activity. It also stimulates adaptations in vital organs of the individual (Bong, 2009; Nasr El-Din, 2004). The program is based on gradual progression of training units and good knowledge of learning principles (Bin, 2004, Ten and Gerg, 2006). Al-Sokkary and Berekaa (2003) indicated that progressive sports programs without increasing training loads have positive effects on functional and technical abilities of female students in addition to decreasing injuries. Exercises improve muscular work and working muscles during initiating the required technical skills. Improving muscular strength should reflect the relative importance of these muscles to the specific activity performed (Al-Sokkary and Berekaa, 2003, Renny, 1997).

The researchers reviewed several previous studies before designing the program (Bin, 2004; Zaky, 2013; Ibrahim et al., 2017; Al-Osili, 2013; Soliman (2005; Shalaby, 2015; Shalaby et al., 2012; Al-Hassani, 2005, Mahmoud and Rasmi 1990; Berken and Shermer, 2001; Shalaby, 2015, Shalaby, et al., 2017a; Shalaby et al., 2012d; Shalaby et al., 2012b; Shalaby, 2017a; Shalaby, 2015; Shalaby, 2017b; Shalaby et al., 2012c, Shalaby, 2017). The program was designed as follows:



## Objectives

- To identify the effects of the recommended water sports program on the concentrations of ploy-unsaturated fatty acids in children with Autism Spectrum Disorder.
- To identify the effects of the recommended water sports program on the severity of disorder in children with Autism Spectrum Disorder.

## Planning

Planning is the process by which the program is designed based on linking guidance policies with its long-term objectives in addition to identifying its path and how to initiate it. Furthermore, it identifies any developments that can happen during application and how to deal with them. When planning the program, the following points were considered:

1. Variety in activities so that children don't get bored.
2. Each child is in good health and doesn't suffer any pain that could distract him/her
3. Using multiple stimulations with specific stimulations for each child.
4. Arrangement and organization before initiation with identification of roles for the child, researchers and assistants.
5. Identifying specific aspects of each child as possible to tailor the experience according to individual differences.
6. Choosing exercises that fulfill the program objectives.
7. Using negative reinforcement with simple punishment, temporary exclusion and ignoring the child
8. Using positive reinforcements with social, material and spiritual support.
9. Children should feel comfortable and safe with suitable loads, repetitions and intensities.
10. Using simple instructions
11. Autistic children feel angry when routine work is suddenly changed
12. Autistic children lack clear thinking
13. Senses lack the ability to transfer stimulants to the nervous system.

## Criteria for choosing participants

1. Diagnosis of Autism Spectrum Disorder
2. The children are free of any other diseases or disorders that may affect results
3. Punctuality in attending the training program.
4. The children are not recruited in any other scientific research works

## Content

The program includes a cheerful part with games and exercises in water. The program includes (36) units, each unit lasts for 40 minutes. It is initiated in a small pool (25 x 12 m), in Aswan Sports Club. Timeframe is as follows:

- Number of months: (3)
- Number of weeks: (12)
- Number of units: (36)
- Number of monthly units: (12)
- Number of units per week: (3).

**Table 7** Timeframe of the recommended water sports program

| Stage  | Number of weeks | Number of units per week | Number of units per stage | Intensity | Unit duration | Weekly duration |
|--------|-----------------|--------------------------|---------------------------|-----------|---------------|-----------------|
| First  | 4               | 3                        | 12                        | Light     | 40            | 120             |
| Second | 4               | 3                        | 12                        | Moderate  | 40            | 120             |
| Third  | 4               | 3                        | 12                        | Moderate  | 40            | 120             |
| Fourth | 12              |                          | 36                        |           | 40            | 360             |

The program was divided into units as follows:

- Unit one: It aims to relative communication among researchers, assistants and autistic children (the child should recognize the researchers and assistants).

- Unit two: it aims to learn to put the face in water
- Unit three: it aims to focus and achieve eye movement coordination
- Unit four: it aims to stimulate the nervous system through resisting water
- Unit five: it aims to auditory stimulation and follow directions.
- Unit six: it aims to learn relaxation and controlling movements.
- Unit seven: it aims to improve muscular strength of the back and neck in addition to focus.
- Unit eight: it aims to mimic movements and play with others.
- Unit nine: it aims to awareness with others
- Unit ten: it aims to understanding causative relations.
- Unit eleven: it aims to improving leg muscles strength.

Each lesson is applied individually for each child using incentives loved by the child and identified during the pilot study with the child, parents and assistants. A variety of incentives should be used including cheers and verbal encouragement.

The researchers integrated exercises with moderate intensities to suite individual differences among children and provide them with maximum range of interaction with assistants and researchers to increase the concentration levels of poly-unsaturated fatty acids and the severity of disorder among them. The program content was presented to experts to identify their opinions (table 7 & 8).

**Table 8** Timeframe of the training unit

| Part              | Duration (min) |
|-------------------|----------------|
| Introduction      | 5              |
| Preliminary part  | 10             |
| Learning activity | 20             |
| Conclusion        | 5              |

#### Post-measurements

Post-measurements were taken on 21-11-2016 following the same protocol of pre-measurements.

#### Statistical treatment

The researchers used SPSS software to calculate the following: mean – SD – Wilcoxon (z) value – squewness

### 3. RESULTS

**Table 9** Difference Significance (Z value) between pre- and post-measurements of participants on poly-unsaturated fatty acids (Abd Al-Daiem(2016) (n=5)

| Variables          | Direction | Number | Mean of ranks | Sum of ranks | Z      | P     |
|--------------------|-----------|--------|---------------|--------------|--------|-------|
| Myristoleic        | +         | 5      | 3.00          | 15.00        | *2.023 | 0.043 |
|                    | -         | 0      | 0.00          | 0.00         |        |       |
|                    | =         | 5      |               |              |        |       |
| Pentadecenoic Acid | +         | 5      | 3.00          | 15.00        | *2.023 | 0.043 |
|                    | -         | 0      | 0.00          | 0.00         |        |       |
|                    | =         | 5      |               |              |        |       |
| Palmitoleic Acid   | +         | 5      | 3.00          | 15.00        | *2.023 | 0.043 |
|                    | -         | 0      | 0.00          | 0.00         |        |       |
|                    | =         | 5      |               |              |        |       |
| Oleic Acid         | +         | 5      | 2.00          | 4.00         | *2.023 | 0.043 |
|                    | -         | 0      | 3.67          | 11.00        |        |       |
|                    | =         | 5      |               |              |        |       |
| Linoleic Acid      | +         | 5      | 1.00          | 1.00         | *2.023 | 0.043 |
|                    | -         | 0      | 3.50          | 14.00        |        |       |
|                    | =         | 5      |               |              |        |       |

(Z) value = 1.97

Table (9) showed statistically significant differences between pre- and post-measurements of poly-unsaturated fatty acids (Abd Al-Daiem, 2016) of participants in favor of post-measurements.

**Table 10** Difference Significance (Z value) between pre- and post-measurements of participants on poly-unsaturated fatty acids (Nivan (2014) (n=5)

| Variables                                   | Direction | Number | Mean of ranks | Sum of ranks | Z      | P     |
|---|-----------|--------|---------------|--------------|--------|-------|
| C18: 3w3 (Linolenic Acid)                   | +         | 5      | .00           | .00          | -1.604 | 0.109 |
|   | -         | 0      | 2.00          | 6.00         |        |       |
|   | =         | 5      |               |              |        |       |
| C20:2 (Cis-11,14 –Eicosatrienoic Acid)      | +         | 5      | .00           | .00          | -1.342 | 0.180 |
|   | -         | 0      | 1.50          | 3.00         |        |       |
|   | =         | 5      |               |              |        |       |
| C20:3w6 (Cis -8,11,14- Eicosatrienoic Acid) | +         | 5      | 2.00          | 2.00         | 0.447  | 0.655 |
|   | -         | 0      | 1.00          | 1.00         |        |       |
|   | =         | 5      |               |              |        |       |
| C22:1w9 (Erucic Acid)                       | +         | 5      | .00           | .00          | -1.342 | 0.180 |
|   | -         | 0      | 1.50          | 3.00         |        |       |
|   | =         | 5      |               |              |        |       |

(Z) value = 1.97

Table (10) showed statistically significant differences between pre- and post-measurements of poly-unsaturated fatty acids (Nivan, 2014) of participants in favor of post-measurements.

**Table 11** Difference Significance (Z value) between pre- and post-measurements of participants on severity of disorder (Abd Al-Daiem(2016) (n=5)

| Variables            | Direction | Number | Mean of ranks | Sum of ranks | Z       | P     |
|----------------------|-----------|--------|---------------|--------------|---------|-------|
| Relation with others | +         | 5      | 3.00          | 15.00        | *2.236- | 0.025 |
|                      | -         | 0      | 0.00          | 0.00         |         |       |
|                      | =         | 5      |               |              |         |       |
| Mimicry              | +         | 5      | 3.00          | 15.00        | *2.23-  | 0.025 |
|                      | -         | 0      | 0.00          | 0.00         |         |       |
|                      | =         | 5      |               |              |         |       |
| Emotional response   | +         | 5      | 3.00          | 15.00        | *2.236  | 0.025 |
|                      | -         | 0      | 0.00          | 0.00         |         |       |
|                      | =         | 5      |               |              |         |       |
| Body use             | +         | 5      | 3.00          | 15.00        | *2.236  | 0.025 |
|                      | -         | 0      | 0.00          | 0.00         |         |       |
|                      | =         | 5      |               |              |         |       |
| Objects use          | +         | 5      | 3.00          | 15.00        | *2.236  | 0.025 |
|                      | -         | 0      | 0.00          | 0.00         |         |       |
|                      | =         | 5      |               |              |         |       |

(Z) value = 1.97

Table (11) showed statistically significant differences between pre- and post-measurements of severity of disorder (Abd Al-Daiem, 2016) (relation with others – mimicry – emotional response – body use – objects use) of participants in favor of post-measurements.

**Table 12** Difference Significance (Z value) between pre- and post-measurements of participants on severity of disorder (Nivan (2014) (n=5)

| Variables                          | Direction | Number | Mean of ranks | Sum of ranks | Z      | P     |
|------------------------------------|-----------|--------|---------------|--------------|--------|-------|
| Adaptation                         | +         | 5      | 3.00          | 15.00        | *2.236 | 0.025 |
|                                    | -         | 0      | .00           | .00          |        |       |
|                                    | =         | 5      |               |              |        |       |
| Visual response                    | +         | 5      | 3.00          | 15.00        | *2.236 | 0.025 |
|                                    | -         | 0      | .00           | .00          |        |       |
|                                    | =         | 5      |               |              |        |       |
| Auditory response                  | +         | 5      | 3.00          | 15.00        | *2.236 | 0.025 |
|                                    | -         | 0      | .00           | .00          |        |       |
|                                    | =         | 5      |               |              |        |       |
| Tactile, smell and taste responses | +         | 5      | 3.00          | 15.00        | *2.236 | 0.025 |
|                                    | -         | 0      | .00           | .00          |        |       |
|                                    | =         | 5      |               |              |        |       |
| Level of cognitive response        |           | 5      | 3.00          | 15.00        | *2.236 | 0.025 |
|                                    |           | 0      | .00           | .00          |        |       |
|                                    |           | 5      |               |              |        |       |

(Z) value = 1.97

Table (12) showed statistically significant differences between pre- and post-measurements of severity of disorder (Nivan, 2014) (adaptation – visual response – auditory response – tactile, smell and taste responses – level of cognitive response) of participants in favor of post-measurements.

**Table 13** Difference Significance (Z value) between pre- and post-measurements of participants on severity of disorder (Al-Abadi, 2005) (n=5)

| Variables                | Direction | Number | Mean of ranks | Sum of ranks | Z      | P     |
|--------------------------|-----------|--------|---------------|--------------|--------|-------|
| Fear and nervousness     | +         | 5      | 3.00          | 15.00        | *2.236 | 0.025 |
|                          | -         | 0      | .00           | .00          |        |       |
|                          | =         | 5      |               |              |        |       |
| Verbal communication     | +         | 5      | 3.00          | 15.00        | *2.236 | 0.025 |
|                          | -         | 0      | .00           | .00          |        |       |
|                          | =         | 5      |               |              |        |       |
| Non-verbal communication | +         | 5      | 3.00          | 15.00        | *2.236 | 0.025 |
|                          | -         | 0      | .00           | .00          |        |       |
|                          | =         | 5      |               |              |        |       |
| Activity level           | +         | 5      | 3.00          | 15.00        | *2.236 | 0.025 |
|                          | -         | 0      | .00           | .00          |        |       |
|                          | =         | 5      |               |              |        |       |
| General impression       | +         | 5      | 3.00          | 15.00        | *2.236 | 0.025 |
|                          | -         | 0      | .00           | .00          |        |       |
|                          | =         | 5      |               |              |        |       |
| Sum                      | +         | 5      | 3.00          | 15.00        | *2.236 | 0.025 |
|                          | -         | 0      | .00           | .00          |        |       |
|                          | =         | 5      |               |              |        |       |

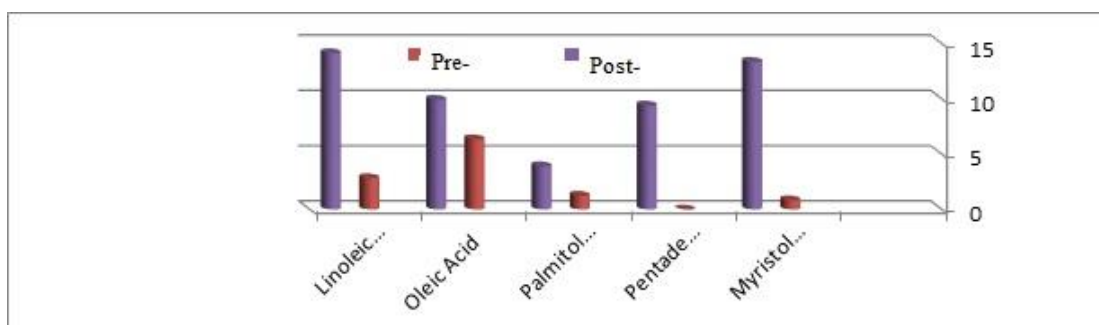
(Z) value = 1.97

Table (13) showed statistically significant differences between pre- and post-measurements of severity of disorder (3) (fear and nervousness – verbal communication – non-verbal communication – activity level – general impression – sum of score) of participants in favor of post-measurements.

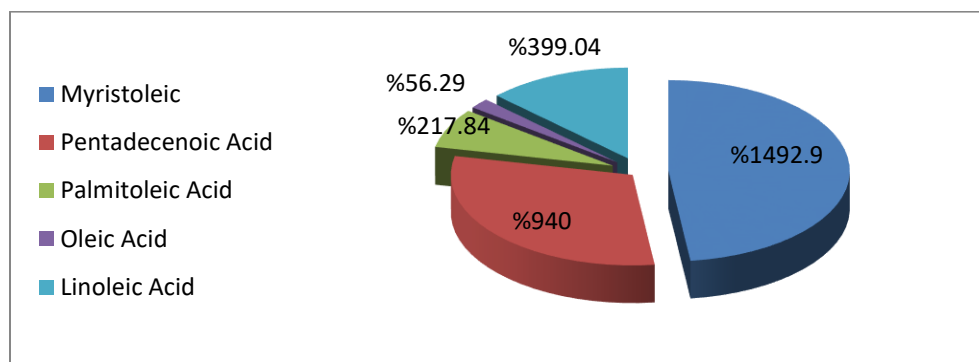
**Table 14** Improvement percentage between pre- and post-measurements of participants on poly-unsaturated fatty acids (Abd Al-Daiem, 2016) (n=5)

| Variables          | Pre-  |       | Post-  |       | Improvement % |
|--------------------|-------|-------|--------|-------|---------------|
|                    | Mean  | SD    | Mean   | SD    |               |
| Myristoleic        | 0.839 | 0.554 | 13.365 | 4.880 | %1493         |
| Pentadecenoic Acid | 0.000 | 0.000 | 9.409  | 3.898 | %940          |
| Palmitoleic Acid   | 1.250 | 0.562 | 3.923  | 3.348 | %218          |
| Oleic Acid         | 6.354 | 5.910 | 9.931  | 5.425 | %56           |
| Linoleic Acid      | 2.835 | 1.091 | 14.148 | 8.513 | %399          |

Table (14) showed that improvements percentages between pre- and post-measurements ranged from 56% to 1493%.



**Figure 6** Means of pre-and post-measurements of poly-unsaturated fatty acids (Abd Al-Daiem, 2016)

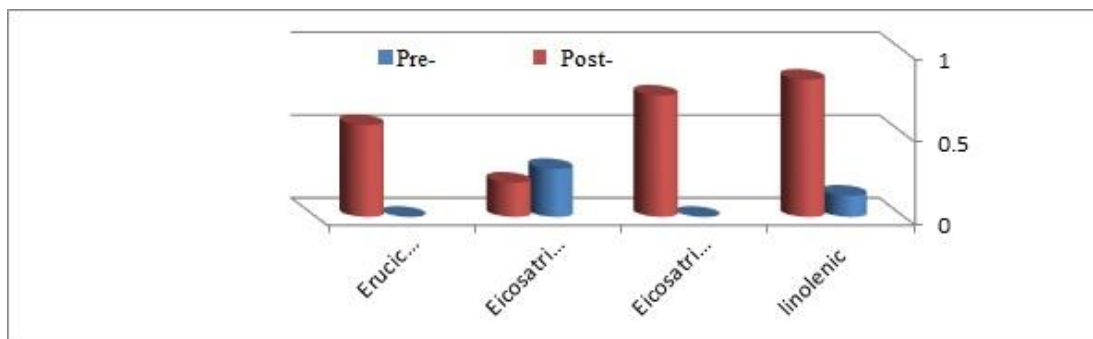


**Figure 7** Improvement percentages between pre-and post-measurements of poly-unsaturated fatty acids (Abd Al-Daiem, 2016)

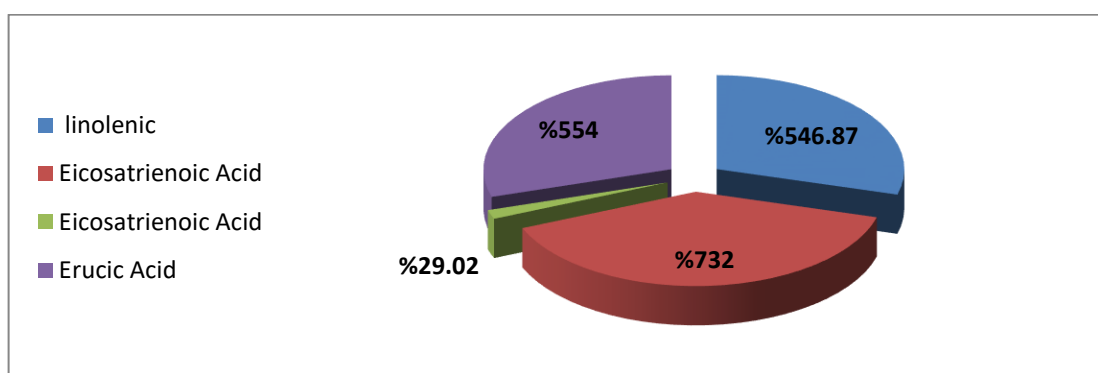
**Table 15** Improvement percentage between pre- and post-measurements of participants on poly-unsaturated fatty acids (Nivan, 2014) (n=5)

| Variables                                  | Pre-  |       | Post- |       | Improvement % |
|--|-------|-------|-------|-------|---------------|
|  | Mean  | SD    | Mean  | SD    |               |
| C18: 3w3 (Linolenic Acid)                  | 0.128 | 0.287 | 0.828 | 0.932 | %547.8        |
| C20:2 (Cis-11,14 –Eicosatrienoic Acid)     | 0.000 | 0.000 | 0.732 | 1.107 | %732          |
| C20:3w6 (Cis -8,11,14-Eicosatrienoic Acid) | 0.289 | 0.646 | 0.206 | 0.461 | %29.2         |
| C22:1w9 (Erucic Acid)                      | 0.000 | 0.000 | 0.554 | 0.771 | %554          |

Table (15) and figure 6 & 7 showed that improvements percentages between pre- and post-measurements ranged from 29.2% to 547.8%.



**Figure 8** Means of pre-and post-measurements of poly-unsaturated fatty acids (Nivan, 2014)

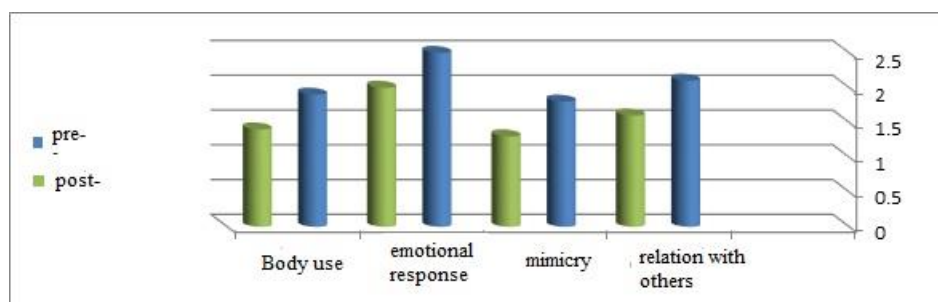


**Figure 9** Improvement percentages between pre-and post-measurements of poly-unsaturated fatty acids (Nivan, 2014)

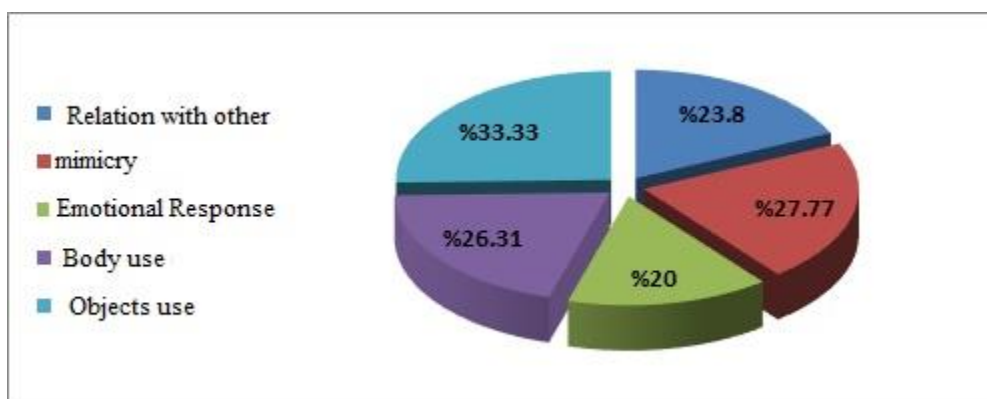
**Table 16** Improvement percentage between pre- and post-measurements of participants on severity of disorder (Abd Al-Daiem, 2016) (n=5)

| Variables            | Measurement | Pre-  |       | Post- |       | Improvement % |
|----------------------|-------------|-------|-------|-------|-------|---------------|
|                      |             | Mean  | SD    | Mean  | SD    |               |
| Relation with others | Point       | 2.100 | 0.547 | 1.600 | 0.547 | %23.80        |
| Mimicry              | Point       | 1.800 | 0.273 | 1.300 | 0.273 | %27.77-       |
| Emotional response   | Point       | 2.500 | 0.000 | 2.000 | 0.000 | %20.00        |
| Body use             | Point       | 1.900 | 0.223 | 1.400 | 0.223 | %26.31        |
| Objects use          | Point       | 1.500 | 0.000 | 1.000 | 0.000 | %33.33        |

Table (16) and figure 8 & 9 showed that improvements percentages between pre- and post-measurements of severity of disorder (1) ranged from 20% to 33.33%.



**Figure 10** Means of pre-and post-measurements of severity disorder (Abd Al-Daiem, 2016)

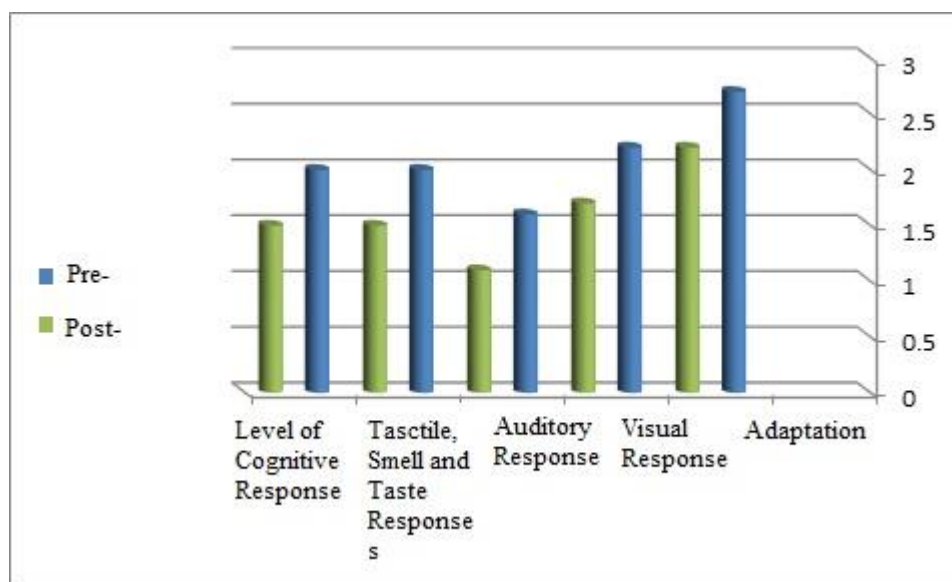


**Figure 11** Improvement percentages between pre- and post-measurements of severity of disorder (Abd Al-Daiem, 2016)

**Table 17** Improvement percentage between pre- and post-measurements of participants on severity of disorder (Nivan, 2014) (n=5)

| Variables                          | Measurement | Pre-  |       | Post- |       | Improvement % |
|------------------------------------|-------------|-------|-------|-------|-------|---------------|
|                                    |             | Mean  | SD    | Mean  | SD    |               |
| Adaptation                         | Point       | 2.700 | 0.273 | 2.200 | 0.273 | %18.51        |
| Visual response                    | Point       | 2.200 | 0.273 | 1.700 | 0.273 | %22.72        |
| Auditory response                  | Point       | 1.600 | 0.223 | 1.100 | 0.223 | %31.25        |
| Tactile, smell and taste responses | Point       | 2.000 | 0.000 | 1.500 | 0.000 | %25.00        |
| Level of cognitive response        | Point       | 2.000 | 0.000 | 1.500 | 0.000 | %2.00         |

Table (17) and figure 10 & 11 showed that improvements percentages between pre- and post-measurements of severity of disorder (2) ranged from 2% to 31.25%.



**Figure 12** Means of pre- and post-measurements of severity disorder (Nivan, 2014)

**Table 18** Improvement percentage between pre- and post-measurements of participants on severity of disorder (Nivan, 2014) (n=5)

| Variables            | Measurement | Pre-  |       | Post- |       | Improvement % |
|----------------------|-------------|-------|-------|-------|-------|---------------|
|                      |             | Mean  | SD    | Mean  | SD    |               |
| Fear and nervousness | Point       | 2.400 | 0.223 | 1.900 | 0.223 | %20.83        |
| Verbal communication | Point       | 2.200 | 0.447 | 1.700 | 0.447 | %22.72        |
| Non-verbal           | Point       | 2.000 | 0.000 | 1.500 | 0.000 | %25.00        |



|                    |       |        |       |        |       |        |
|--------------------|-------|--------|-------|--------|-------|--------|
| communication      |       |        |       |        |       |        |
| Activity level     | Point | 2.200  | 0.447 | 1.700  | 0.447 | %22.72 |
| General impression | Point | 2.500  | 0.000 | 2.000  | 0.000 | %20.00 |
| Sum                | Point | 31.300 | 0.908 | 24.100 | 1.024 | %23.00 |

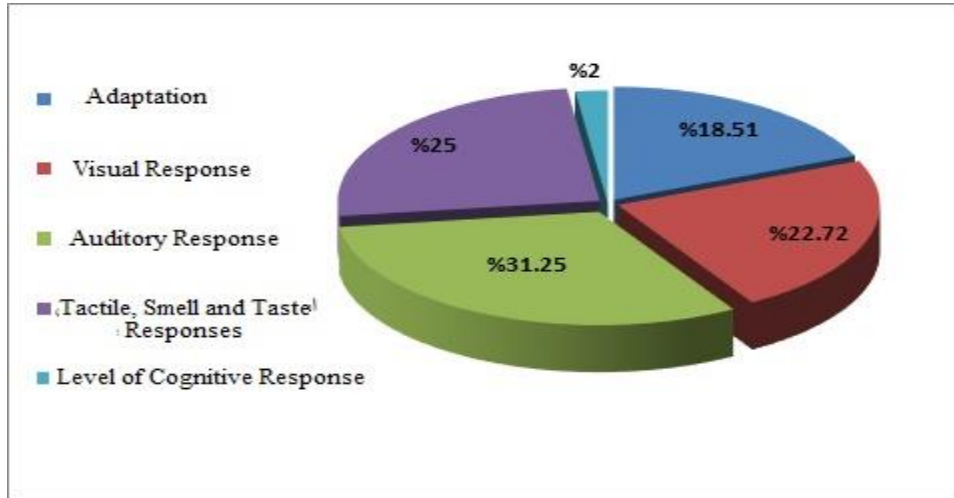


Figure 13 Improvement percentages between pre-and post-measurements of severity of disorder (Nivan, 2014)

Table (18) and figure 12-15 showed that improvements percentages between pre- and post-measurements of severity of disorder (3) ranged from 20% to 25%.

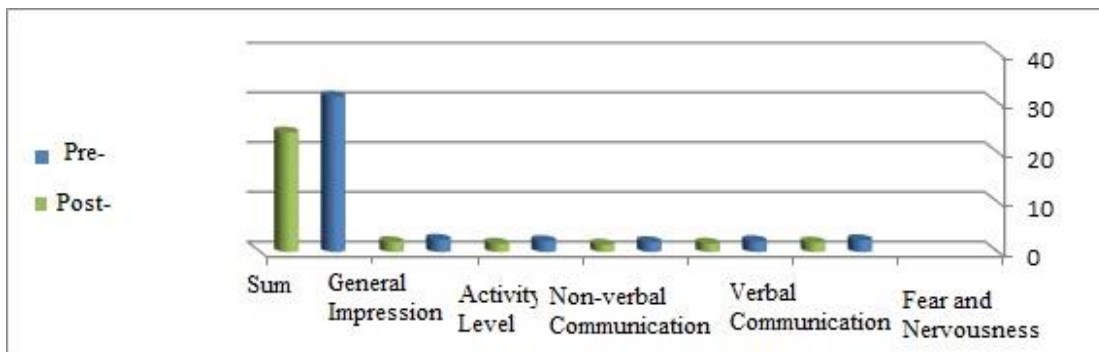


Figure 14 Means of pre-and post-measurements of severity disorder (Al-Abadi, 2005)

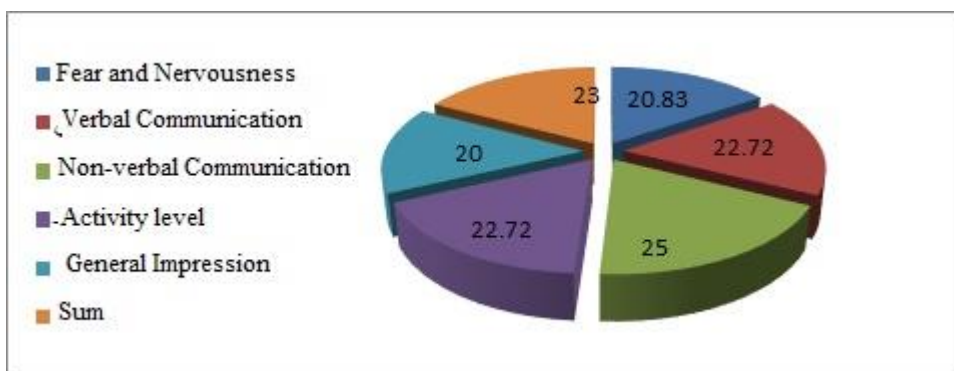


Figure 15 Improvement percentages between pre-and post-measurements of severity of disorder (Al-Abadi, 2005)

## 4. DISCUSSION

Table (9) indicated statistically significant differences between pre- and post-measurements of participants on poly-unsaturated fatty acids (Myristoleic - Pentadecenoic Acid - Palmitoleic Acid - Oleic Acid – Linoleic Acid) in favor of post-measurements. The researchers think that these improvements are due to the effects of the recommended water sports program on the concentration of poly-unsaturated fatty acids in children with autism spectrum disorder. This is consistent with the results of Khalil (2006) (Shalaby et al., 2012d) who indicated similar improvements in the concentrations of poly-unsaturated fatty acids (Myristoleic - Pentadecenoic Acid - Palmitoleic Acid - Oleic Acid – Linoleic Acid) in children with autism spectrum disorders.

Andressi (1997) indicated that fatty acids are required for energy production and oxygen transfer into blood stream. It contributes in forming hemoglobin, growth, mitosis and nervous functions. Fatty acids exist with high concentrations in brain cells as they are essential for transferring neural signals necessary for brain function (Anderson, 2004). This is consistent with Taha (2010) who indicated that sports programs affect body fats as it metabolizes them into fatty acids and glycerol needed by autistic children (Nasr, 2002).

Salama (1999) indicated that the concentration level of fatty acids in fatty tissues depend not only on fats metabolism but also on its activity in plasma and rate of reconstructing fatty acids by FFA of the fatty acids and fatty cells (Shalaby et al., 2017a). Al-Toukhi (2003) indicated the importance and effects of physical education and recreational activities and programs in improving personal and social adaptation of children with special needs.

With the continuation of physical training, percentage of fatty acids from fatty cells in blood increases till it is equal to consumption rates or even exceeds it. This increases the concentration of fatty acids in blood. Fatty acids increase with the increase of training intensity and this prevents accumulation of lactic acid. With prolonged training periods fatty acids are oxidized in plasma although oxidizing fatty acids to a specific percentage depends on the activity of Beta Oxidase and Krebs cycle enzymes but the oxidative ability of skeletal muscles doesn't depend on rates of using fatty acids in training (Shalaby et al., 2017a).

Autism is a disorder with basic syndromes that appear on the child before the 30th month of age. This includes decreases in growth rates, responses to sensory stimuli, speech, language and sense of belonging (Rateb, 1990). Fatty acids play a major role in forming cell membranes, especially the retina, the brain and the heart. The human body uses fatty acids to produce hormone-like substances that regulate several processes including the inflammatory and immunological responses (Bin, 2004; Shalaby et al., 2017b). Well-designed sports programs lead to adaptations in body systems. This includes decreased heart rate in rest in addition to major changes in heart volume, cardiac pumping, density of blood vessels, blood volume and hemoglobin delivered to muscles (Al-Kot, 1999). This is consistent with Ismail (2010) who confirmed that practicing sports exercises had positive effects on omega 3 levels and other body physiological variables.

Table (10) indicated no statistically significant differences between the pre- and post-measurements of poly-unsaturated fatty acids (Linolenic - Eicosatrienoic Acid - Eicosatrienoic Acid - Erucic Acid) for the research group. This is not consistent with the results of Khalil, Rehab O. (2006) who indicated that poly-unsaturated fatty acids (Linolenic - Eicosatrienoic Acid - Eicosatrienoic Acid - Erucic Acid) improved significantly but with the use of medical drugs. We can conclude that methods of treating autism spectrum disorder are multiple and integrated (including sport, Quran, music, good nutrition and medical drugs) to achieve the desired result (Khalil, 2006).

Van Cassel (2001) indicated that Linoleic acid decreased significantly in children with autism compared with control (Ostlandl, 1999). This is consistent with Mostafa (2005) who indicated that children with autism have significantly lower levels of Linoleic acid compared with other poly-unsaturated fatty acids. This proves the first hypothesis stating "There are statistically significant differences between the pre- and post-measurements of poly-unsaturated fatty acids (Myristoleic - Pentadecenoic Acid - Palmitoleic Acid - Oleic Acid – Linoleic Acid) in favor of post-measurements, while there are no statistically significant differences between the pre- and post-measurements of the following variables (Linolenic – Eicosatrienoic Acid Cis 11,14 – Eicosatrienoic Acid Cis 8,11,14 – Erucic Acid).

Table (11) showed statistically significant differences between pre- and post-measurements of severity of disorder (Abd Al-Daiem, 2016) (relation with others – mimicry – emotional response – body use – objects use) of participants in favor of post-measurements. Table (12) showed statistically significant differences between pre- and post-measurements of severity of disorder (Nivan, 2014) (adaptation – visual response – auditory response – tactile, smell and taste responses – level of cognitive response) of participants in favor of post-measurements. Table (13) showed statistically significant differences between pre- and post-measurements of severity of disorder (Al-Abadi, 2005) (fear and nervousness – verbal communication – non-verbal communication – activity level – general impression – sum of score) of participants in favor of post-measurements.

The researcher thinks that these improvements are due to the recommended sports activities program for children with autism spectrum disorder. This is consistent with Nivan (2014), Teran Greg (2006), Anderson (2004), Berken and Shermer (2001), Cynthia Marie (2000) and Renny-Hogon (1997) who indicated the effectiveness of sports programs in improving communication, social interaction and basic skills in addition to behaviors of children with autism spectrum disorders. But they didn't talk about water sports programs.

Danila (2002) asserted the importance of sports activities and its role in improving the psychological aspects of mentally retarded persons either on the emotional level or behavioral modification. This is consistent with Al- Al-Osili, (2013) who found improvements in autistic children on social communication, expression, observation, mimicry and fear. Abdallah, Mohamed (2013) indicated improvements in autistic children when using an aquatic sports program on non-verbal communication that included body use and emotional response (Rateb, 1997). Soliman (2005) indicated that children with autism suffer from clear limitations in non-verbal communication including eye-contact, facial expressions, body positions and gestures in addition to limitations in relationships and the desire for group play.

Danial et al. (1997) indicated that children with special mental needs respond to the programs concentrating more on sports activities as it enables them to express themselves non-verbally in addition to fostering success, self-confidence and adaptation. This improves the child's character and abilities. Al-Hader (2008) indicated improvements in social interaction, focus, social communication and decreased isolation and introversion for children with autism when using training programs based on games. Regular participation in sports activities helps children with special mental needs to achieve psychological balance leading to self-satisfaction and quick integration into the community (Janet, 1996). Al-Hassani, Samer (2005) asserted the effectiveness of an educational program using games in improving verbal communication for children with autism (Al-Hassani, 2005). Al-I-Osili (2013) indicated that in-water activities help children with autism to feel hand-eye coordination in addition to improving fine motor skills. Blowing things in water strengthens the jaw and breathing muscles. Swimming exercises help children with autism to make use of hyper activity in improving motor abilities and communication through learning in a new environment, the swimming pool, and this improves their motor skills and communication levels.

One of the most important needs of children with special mental needs is the feeling that there are minor differences between them and regular children through providing them with the opportunity to participate actively in playing according to their max abilities (Al-Refai AM, 1999). This proves the second hypothesis stating that "There are statistically significant differences between pre- and post-measurements of severity of disorder in relation with others – mimicry – emotional response – body use – objects use – adaptation – visual response – auditory response – tactile, smell and taste responses – level of cognitive response – fear and nervousness – verbal communication – non-verbal communication – activity level – general impression – sum of score of participants in favor of post-measurements (Shalaby et al., 2007a). Table (14) and figures (7) and (8) showed that improvements percentages between pre- and post-measurements ranged from 56% to 1493% for poly-unsaturated fatty acids (Myristoleic - Pentadecenoic Acid - Palmitoleic Acid - Oleic Acid – Linoleic Acid). Table (15) and figures (9) and (10) showed that improvements percentages between pre- and post-measurements ranged from 29.2% to 547.8% for poly-unsaturated fatty acids (Linolenic - Eicosatrienoic Acid - Eicosatrienoic Acid - Erucic Acid).

The researchers think that these improvements are due to the positive effects of the recommended water sports program on the concentration levels of poly-unsaturated fatty acids in children with autism spectrum disorder. This is consistent with Bu et al. (2006) and Mostafa (2005) who indicated significant improvements on concentration levels of poly-saturated fatty acids in children with autism. Fats are the main source of energy as it provides the body with fatty acids that are very important for physical and mental growth, especially for children with autism. Regular exercises support body ability to metabolize fats to energy at rest and in action. It increases oxygen uptake and caloric burning. It also has a long-term effect on metabolism as it improves cardio-vascular fitness. In addition, resistance exercises increase body production of enzymes that metabolize fats into fatty acids. These fatty acids are released in blood stream and transferred to other tissues like muscles where cells use them. After that, mitochondria metabolize it to produce energy. Therefore, exercises increase body ability to burn fats (Bin, 2001). Fatty acids result from fats metabolism in the guts during moderate intensity physical exercises for a prolonged period of time (Shalaby, 2015).

(Bell et al., 2000), Martineau (1994) and Rapp (2005) indicated similar results with the current study as poly-unsaturated fatty acids concentrations improved. Children with autism suffer a decrease in poly-unsaturated fatty acids, Linoleic and arachidonic acids in plasm, in addition to a significant increase of omega 3 and omega 6 compared with normal children. Furthermore, DHA plasma levels are decreased. Concentration levels of linoleic acid were 76.6%, 52.2%, 53.3% and 33.3% while omega 3 and omega 6 were 44.4% for children with autism. DHA was lower in children with low-stress autism compared with children with high-stress autism. This indicates the importance of DHA for nervous system (Danila, 1997).

Table (16) and figures (11) and (12) showed that improvements percentages between pre- and post-measurements of severity of disorder (Abd Al-Daiem, 2016) (relation with others – mimicry – emotional response – body use 0 objects use) ranged from 20% to 33.33%. Table (17) and figures (13) and (14) showed that improvements percentages between pre- and post-measurements of severity of disorder (Nivan, 2014) (adaptation – visual response – auditory response – tactile, smell and taste responses – level of cognitive response) ranged from 2% to 31.25%. Table (18) and figures (15) and (16) showed that improvements percentages between pre- and post-measurements of severity of disorder (Al-Abadi, 2005) (fear and nervousness – verbal communication – non-verbal communication – activity level – general impression – sum) ranged from 20% to 25%.

The researchers think that these improvement percentages between the pre- and post-measurements are due to the effectiveness of the recommended water sports program applied to children with autism spectrum disorder. This is consistent with Mahrous (2002) and Metwally (2008) who indicated that sign language of autistic children improved due to the swimming program applied to them. In addition, the program improved self-esteem, self-confidence, motivation and other desired behaviors for those children.

Kamal (1998) indicated that communication disturbance with others in autistic children is a multi-façade problem that appears in decreased levels of communication skills, emotional expression or anger, manifested as throwing things away as an expressing for gaining attention or expressing a certain idea that they cannot express correctly. Sadek (1982) indicated the importance of taking good care for children with special mental needs and training them on personal and social skills to relieve them from academic failure and frustration. Berken & Shermer (2001) and Cynthia (2000) indicated that visual responses, adaptation, verbal communication and non-verbal communication are improved in children with autism.

TEACCH is a widely used program all over the world for treating speech and linguistic disorders in autistic children through positive and negative reinforcements. The program improved linguistic skills and non-verbal concepts (Mustafa, 2013). Motor education programs are suitable for children as they are based on stages of motor and physical growth of the child (Al-Faitouri, 2012). Mostafa (1993) indicated that water exercises had positive effects on improving performance, vital capacity and self-esteem towards athletic performance. Ostland (1999), Fennick (2003) and Rapp (2005) indicated that imaginary activities of children with autism and other developmental handicaps improved in swimming classes as swimming is a suitable activity for children with autism as the child remain calm for nearly 6 hours after the session. Motor education for individuals with special needs play a vital role through adaptive or modification programs. These programs are useful for them according to their needs as it helps them improve their physical, mental and social growth and not to be a burden over the society (Ibrahim, 1998; Shalaby, 2018).

This proves the third hypothesis stating "There are statistically significant improvement percentages between pre- and post-measurements of children with autism spectrum disorder on poly-unsaturated fatty acids and severity of disorder in favor of post-measurements".

## 5. CONCLUSIONS

According to this research aims, hypotheses, methods and results, the researchers concluded the following:

1. The recommended water sports program had positive effects on modifying negative behaviors and acquiring desired behaviors in addition to decreasing the severity of disorder in children with autism spectrum disorders.
2. The recommended water sports program had positive effects improving the concentration levels of poly-unsaturated fatty acids (Myristoleic - Pentadecenoic - Palmitoleic Acid - Oleic Acid – Linoleic Acid) in children with autism spectrum disorders.
3. The recommended water sports program had positive effects on improving the severity of disorder (relations with others – mimicry – emotional response 0 body use – objects use) in children with autism spectrum disorders.
4. The recommended water sports program had positive effects on improving the severity of disorder (verbal communication – non-verbal communication – activity level – visual response – auditory response – cognitive response) in children with autism spectrum disorders.

### Recommendations

According to these conclusions, the researchers recommend the following:

1. Applying the recommended water sports program
2. Faculties of physical education should design specific programs for individuals with special needs in general, especially for children with autism, as these categories can be invested.
3. Children with autism should learn in groups to improve their communication skills.

4. Preparing a special program for graduates of faculty of physical education to deal with children with autism.
5. Providing special swimming pools for persons with special needs, especially with autism, with specialized instructors and not to limit them on big clubs only.
6. Performing more studies on the benefits of sports in general, and especially swimming, for children with autism.

**Funding:** This research received no external funding.

**Conflicts of Interest:** The authors declare no conflict of interest.

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